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HOSKINS-WESTERN-SONDEREGGER INC LINCOLN NE

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NATIONAL DAM SAFETY PROGRAM. JOHNSON LAKE DAM (MO 106501), MISSO--ETC(U)

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JOHNSON LAKE DAM

CARROLL COUNTY, MISSOURI

NO. 10880

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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JOHNSON LAKE DAM
CARROLL COUNTY, MISSOURI
MISSOURI INVENTORY NO. MO 10650

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
HOSKINS-WESTERN-SONDEREGGER, INC.
CONSULTING ENGINEERS
LINCOLN, NEBRASKA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR

GOVERNOR OF MISSOURI

JULY, 1980

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

SUBJECT: Johnson Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Johnson Lake Dam (MO 10650).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- a. Spillway will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- b. Overtopping of the dam could result in failure of the dam.
- c. Dam failure significantly increases the hazard to loss of life downstream.

Additionally, the severe erosional damage to the upstream slope and the undermining of the crest result in an unsafe condition.

SIGNED

24 DEC 1980

SUBMITTED BY:

Chief, Engineering Division

Date

APPROVED BY:

Colonel, CE, District Engineer

29 DEC 1980

Date

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM
ASSESSMENT SUMMARY

| | |
|--------------------|---------------------------|
| Name of Dam | Johnson Lake Dam |
| State Located | Missouri |
| County Located | Carroll County |
| Stream | Offstream Standley Branch |
| Date of Inspection | July 1, 1980 |

Johnson Lake Dam was inspected by an interdisciplinary team of engineers, ~~from Hoskins-Western-Sonderogger, Inc.~~ The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and were developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Johnson Lake Dam has a height of twenty-five (25) feet and a storage capacity of fifty-eight (58) acre-feet. In accordance with the guidelines a small size dam has a height greater than or equal to twenty-five (25) feet but less than forty (40) feet and a storage capacity greater than or equal to fifty (50) acre-feet but less than one thousand (1,000) acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category. Johnson Lake Dam is classified as a small size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends approximately two (2) miles downstream of the dam. Within the damage zone are thirty (30) or more dwellings, U.S. Highway 65 and a football field all of which are located in the City of Carrollton.

Our inspection and evaluation indicates that the spillway does not meet the criteria set forth in the recommended guidelines for a small dam having a high hazard potential. Considering the number and nature of the downstream hazards the Probable Maximum Flood is the appropriate spillway design flood. The spillway will not pass the Probable Maximum Flood or the 100-year flood (1% probability flood, a flood having a 1% chance of being exceeded in any year) without overtopping the dam. The spillway will pass 15% of the Probable Maximum Flood (PMF) without overtopping the dam. The Probable Maximum Flood is defined as the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

A


Johnson Lake Dam is in very poor condition and has a serious potential of failure due to severe erosional damage of the upstream face and the crest; undermining of the crest; dense tree and brush growth on the crest and downstream slope; and a severely inadequate spillway. There apparently has been no maintenance work done on this dam for many years.

Based on the observations made during the field inspection, the following recommendations are made and should be implemented by the owner on a very high priority basis:


- a. Lower the water level in the lake in order to stop further erosional damage to the dam and to facilitate reconstruction, repairs and stabilization of the upstream slope and crest of the dam.
- b. Remove all trees and brush from the crest and downstream slope in preparation for repairs and reconstruction.
- c. Conduct seepage and stability analyses comparable to the requirements of the guidelines (including earthquake loads).
- d. Increase the height of the dam and/or construct spillway(s) through the left or right (or both) abutments as necessary to pass the Probable Maximum Flood without overtopping the dam.
- e. The services of an engineer experienced in the design and construction of earth dams should be obtained to provide guidance in lowering of the water level in the lake and in the removal of the trees and brush. In addition he should conduct seepage and stability analyses and should design remedial and protective measures as required.


The existing dam is in such condition that problems normally considered as maintenance problems are magnified in scope and of necessity become major parts of the work necessary to rehabilitate the dam.

After rehabilitation work is completed it is recommended that a regular program of inspection and maintenance be initiated in order to protect the integrity of the dam.


Rey S. Decker
E-3703


Gordon Jamison


Garold Ulmer
E-19246


Harold P. Hoskins, Chairman of the Board
Hoskins-Western-Sonderegger, Inc.
E-8696

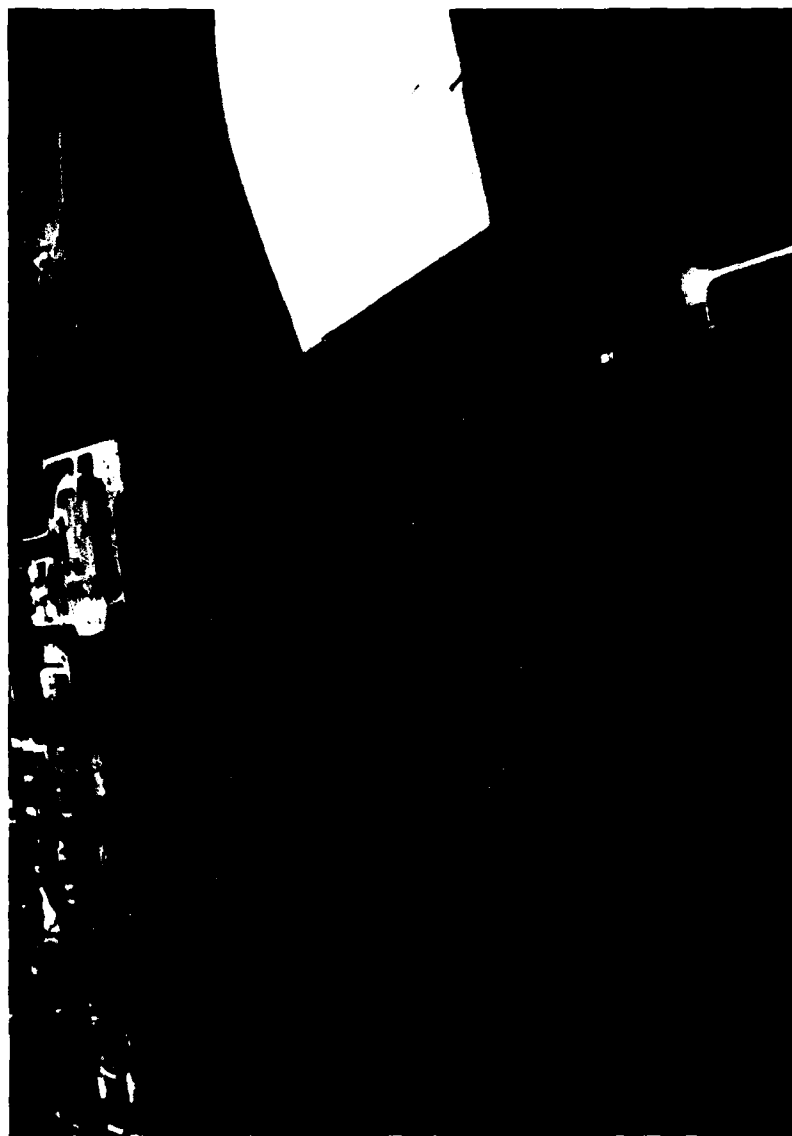


PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
JOHNSON LAKE DAM - MO 10650
CARROLL COUNTY, MISSOURI

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

- a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of Johnson Lake Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

- a. Description of Dam and Appurtenances.
 - (1) The dam is an earth fill approximately 1,180 feet long and 25 feet high constructed in a semicircular configuration. The maximum water storage at the minimum top of dam is 58 acre-feet. The dam is located in the dissected till plains area within the Central Lowlands Physiographic Region.
 - (2) The principal (and only) spillway is uncontrolled and consists of an earth spillway cut through the dam embankment on the right end (southwest).
 - (3) Pertinent physical data are given in paragraph 1.3 below.
- b. Location. The dam is located in the central portion of Carroll County, Missouri, approximately one-half mile north of Carrollton as shown on Plate A-2. The dam is shown on Plate A-1 in the SW 1/4 of Section 28, T53N, R23W.

- c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Johnson Lake Dam has a height of 25 feet and a storage capacity of 58 acre-feet. This dam is classified as a small size dam. A small size dam has a height greater than or equal to 25 feet but less than 40 feet and a storage capacity greater than or equal to 50 acre-feet but less than 1,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size category.
- d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines, this dam is in the High Hazard Classification. The estimated damage zone extends about two miles downstream of the dam. Based on visual inspection, there are within the damage zone thirty or more dwellings, U. S. Highway 65, and a football field all of which are located in the City of Carrollton.
- e. Ownership. The dam is owned by the E. C. Johnson Corporation, c/o Mack Duderstadt, 1310 North Jefferson, Carrollton, Missouri 64633.
- f. Purpose of Dam. The dam was constructed primarily for recreation and as a stock pond. It does provide flood protection for the town of Carrollton.
- g. Design and Construction History. The dam was constructed in 1955 by Mr. E. C. Johnson, a contractor (now deceased). Mr. Mack Duderstadt reported that the spillway was changed from the northeast corner over to the southwest corner about 5 to 6 years ago. No other information was available on design or construction of the dam.
- h. Normal Operating Procedure. There are no operating facilities for this dam. The pool level is controlled by rainfall, evaporation, infiltration, and the capacity of the uncontrolled spillway.

1.3 PERTINENT DATA

- a. Drainage Area. 30 acres (0.047 square miles).
- b. Discharge At Damsite.
 - (1) All discharges at the damsite are through an uncontrolled earth spillway cut through the dam embankment. The spillway is located in the right leg of the dam approximately 50 feet from the right abutment.
 - (2) Estimated maximum flood - Unknown

(3) The spillway capacity varies from 0 c.f.s. at elevation 726.9 feet (crest of the spillway) to 40 c.f.s. at elevation 727.4 feet (minimum top of dam).

(4) Total spillway capacity at the minimum top of dam is 40 c.f.s.±

c. Elevations. (Feet above M.S.L.)

(1) Top of dam - 728.0± (nominal); 727.4 (minimum)

(2) Spillway crest - 726.9

(3) Normal pool - 726.9

(4) Observed pool - 725.0

(5) Maximum experienced pool - Unknown

(6) Streambed at centerline - 705 ±

(7) Maximum tailwater - Unknown

d. Reservoir. (Length in Feet)

(1) Minimum Top of Dam - 800 ±

(2) Spillway Crest - 800 ±

e. Storage (Acre-feet).

(1) Top of dam (minimum) - 58 ±

(2) Spillway crest - 54 ±

(3) Normal pool - 54 ±

(4) Observed pool - 43 ±

(5) Maximum experienced pool - Unknown

f. Reservoir Surface (Acres).

(1) Top of dam (minimum) - 7.0 ±

(2) Spillway crest - 6.7 ±

(3) Normal pool - 6.7 ±

(4) Observed pool - 5.7 ±

(5) Maximum experienced pool - Unknown

g. Dam.

- (1) Type - Homogeneous earth fill
- (2) Length - 1,180 ft. \pm
- (3) Height - 25 ft. \pm
- (4) Top width - Varies from 1 ft. (minimum) to 11 ft. (maximum)
- (5) Side Slopes.
 - (a) Downstream - 1V on 1.9H (measured on upper slope)
1V on 4.8H (measured on lower slope)
 - (b) Upstream - 1V on 1.9H (measured)
- (6) Zoning - Unknown
- (7) Impervious core - Unknown
- (8) Cutoff - Unknown
- (9) Grout curtain - Unknown
- (10) Wave protection - None
- (11) Drains - None

h. Diversion Channel and Regulating Tunnel. None

i. Spillway.

- (1) Principal (and only)
 - (a) Type - An uncontrolled earth cut through the right embankment approximately 4-5 feet wide at the bottom of cut to 18 feet wide at top of the crest. Spillway releases through the cut are ponded in a natural depression behind a natural berm extending along the left side of the spillway. The flows are contained until the reservoir pool is about the elevation of the berm, which is only 0.4 to 0.5 feet below the minimum top of the dam.
 - (b) Control section - a natural berm extending along the left side of the spillway for approximately 60 feet contains the flow within a natural depression.
 - (c) Crest elevation - 727.0 (nominal); 726.9 (minimum).
 - (d) Upstream Channel - There is no upstream channel.

(e) Downstream Channel - There is no excavated channel downstream of spillway. The flow would most probably follow the downstream toe of the dam embankment until it reaches the old channel.

j. Regulating Outlets. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No Design data were available for this dam.

2.2 CONSTRUCTION

No construction data were available. It was reported by Mr. Mack Duderstadt that the dam was constructed in 1955 by Mr. E. C. Johnson, a contractor, who is now deceased. The spillway was changed from the northeast corner to the southwest corner about 5 to 6 years ago.

2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. Duderstadt that the spillway has never flowed since its been installed; however, there was evidence that the pool behind the berm in the spillway had eroded a portion of the berm and flow was released over the berm at some time in the past.

2.4 EVALUATION

- a. Availability. No data were available.
- b. Adequacy. The field surveys and visual observations presented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

- a. General. A visual inspection of the Johnson Lake Dam was made on July 1, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska making the inspection were: R. S. Decker, Geotechnical; Gordon Jamison and Garold Ulmer, Hydrology. Mr. Mack Duderstadt, caretaker for the E. C. Johnson Corporation, accompanied the inspection team part of the time.

b. Dam.

- (1) Geology and Soils (abutment and embankment). Johnson Lake Dam is located in the dissected till plains area within the Central Lowlands Physiographic Region. The dam site is in a region where the stratigraphic sequence consists of loess 10 to 20 ft. thick, overlying bedrock and/or glacial till at an undetermined depth.

Bedrock consists of strata belonging to the Marmaton Group, Desmonsian Series, Pennsylvanian System and consists of interlayered sequences of shale, sandstone, limestone and thin beds of coal. Bedrock was not exposed at the site, however, washes in the left abutment contained limestone pebbles. Borings on the downstream slope of the dam showed fat clays (CH) which may have been derived from till. Alluvial materials in the valley bottom are CL probably derived from the loessial uplands.

The soil deposits in the area consist of upland soils of what appears to be the Marshall-Knox soil association. These soils formed on the deep loess deposits that lie adjacent to the Missouri River flood plain. The Marshall soil is positioned on the gently sloping areas while the Knox soil is positioned in the upland valley areas. It is possible that the dam is located in the Sharpsburg-Grundy soil association area which consists of moderately deep loess over glacial till.

- (2) Upstream Slope. The upstream slope is severely eroded with many areas of near vertical slopes extending down 2 to 2.5 feet from the crest and some areas where the crest is undercut or undermined by as much as 1.5 feet. Photos 2, 4, 5, 7 and 8 show the upstream slope.
- (3) Crest. The crest of the dam is partially covered with trees and brush. Wave erosion has severely reduced the width of the crest which now measures from 1 foot or less to about

11 feet. The crest width on the left leg is about 11 feet wide from station 0+00 to 2+50 and 2 to 7 feet wide from station 2+50 to about 5+50. The crest width of the right (south) leg varies from 2 to 5 feet from station 5+50 to about 7+00 where a narrow section, 1 foot or less, extends to about station 8+40. The elevation of the crest is variable, as shown on Plate C-1, and it was difficult to determine the presence of slumps or deformations. Photos No. 3, 4, 5, 6 & 7 show the crest.

- (4) Downstream Slope. The downstream slope is almost completely overgrown with trees and brush. The downstream toe area of the left leg from about station 2+00 to 3+00 is saturated and covered with phreatophytes. No free water was observed on the toe of the right leg; however, water grass was growing 20 to 30 feet out from the toe. A boring on the slope downstream from about station 9+00 and 7 or 8 feet up from the toe showed dry CH soil down to 2 feet where moisture began to show up. There did not appear to be any slumps, slides or deformations on the downstream slope, although the dense growth made observations difficult. Photo No. 9 shows the phreatic vegetation in the wet area along the toe of the left leg. Photos 10, 11 & 12 show the downstream slope. Photo 10 is taken in about the only open space on the downstream slope.
- (5) Miscellaneous. Any extended period of time in the future when the lake level is high and wave action occurs, the narrow section of the crest will undoubtedly breach with a serious potential of complete failure of the dam.

c. Appurtenant Structures.

- (1) The principal (and only) spillway is a narrow cut through the right abutment which outlets into what appears to be an old conservation terrace, the levee or berm of which is only about 1.5 feet lower than the crest of the dam. Measurements of the spillway are shown on Plate C-3. Photo No. 13 shows the spillway cut.
- (2) Drawdown Facilities - There are no drawdown facilities for this dam.

- d. Reservoir Area. The banks around the reservoir show evidence of wave erosion. No slumps or slides were observed around the reservoir. Photo No. 14 shows a portion of the reservoir. It was reported by Mr. Duderstadt that the reservoir is about half silted in so that the depth of the reservoir is at a maximum about ten feet.

- e. Downstream Channel. There is no defined channel for the outlet of the spillway. When water reaches the top of the confining levee or berm (at elevation 727) water spills over the levee and flows down the hill to the old channel. There was no evidence that any major flows had traversed this route.

3.2 EVALUATION

This dam is in very poor condition with a serious potential of failure. Wave erosion has reduced several sections of the crest to a width to one foot or less. The spillway is not effective and provides less than one foot of freeboard for several sections of the dam. Any prolonged high water or overtopping of the dam would certainly breach the structure and result in failure. The apparent clay (CH) composition of the dam is probably the only reason it has not failed to date.

SECTION 4 - OPERATION PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam. The pool level is controlled by rainfall, evaporation, infiltration, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM.

There apparently has been no maintenance on this dam for many years.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

4.5 EVALUATION

There appears to be a serious potential of failure of this structure.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

- a. Design Data. No design data were found for this dam.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Standish, Missouri 7.5 minute topographic quadrangle map. The hydraulic computations for the spillway and dam overtopping discharge ratings were based on data collected in the field at the time of the field inspection.
- c. Visual Observations.
 - (1) The spillway was cut through the crest of the right leg. However, no exit channel was excavated for discharging the flow through the cut. Therefore, the water ponds on the downstream side of the dam within a natural depression. The spillway can only discharge when it gets above a natural berm that extends along the left side of the spillway. Discharges over the berm would most probably flow along the downstream toe of the right leg until reaching the old channel.
 - (2) The crest is badly eroded with crest widths as narrow as 1 foot. This erosion is most probably due to the ponding of water behind the natural berm in the spillway.
- d. Overtopping Potential. The spillway is too small to pass the probable maximum flood or the 1% probabilistic flood without overtopping. The spillway will pass 15% of the probable maximum flood without overtopping the dam. Minor overtopping would possibly endanger the integrity of the dam. The results of the routings through the dam are tabulated in regards to the following conditions:

| Frequency | Inflow Discharge c.f.s. | Outflow Discharge c.f.s. | Maximum Pool Elevation | * Maximum Depth Over Dam | Duration Over Top Hr. |
|-----------|-------------------------------|--------------------------------|------------------------------|--------------------------------|-----------------------------|
| 1% | 160 | 80 | 727.6 | 0.2 | 1+ |
| 1/2 PMF | 270 | 220 | 727.9 | 0.5 | 4+ |
| PMF | 530 | 490 | 728.1 | 0.7 | 6+ |
| 0.15 PMF | 80 | 40 | 727.4 | 0 | 0 |

* Minimum Top of Dam Elevation = 727.4

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard rating and a small size. Therefore, $\frac{1}{2}$ PMF to the PMF is the test for the adequacy of the dam and its spillway. The PMF is the spillway design flood due to the large number of dwellings downstream of the dam.

The estimated damage zone is described in Paragraph 1.2d in this report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. The dam is apparently structurally stable. It has been in place for 25 years with no evidence of structural instability. However, the severe erosion of the upstream face and the almost complete destruction of portions of the crest have created a very serious potential of failure of this structure. Trees growing on or near the erosional remnant of the crest certainly do not add to the safety rating of this dam.
- b. Design and Construction Data. No design or construction data were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Operating Records. There are no controlled operating facilities for this dam.
- d. Post Construction Changes.

It was reported by Mr. Mack Duderstadt that the spillway was changed from the northeast corner to the southwest corner about 5 to 6 years ago.
- e. Seismic Stability. This dam is located in Seismic Zone 1. Due to the poor condition of this dam, it is not known what effect an earthquake of this magnitude might have on the dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

- a. Safety. This dam appears to have a serious potential of failure from breaching and overtopping as a result of uncontrolled erosional damage to the upstream face and the crest. Approximate hydrologic analyses presented in this report indicate that the dam is seriously inadequate since the spillway will only pass 15% of the Probable Maximum Flood without overtopping. Uncontrolled tree growth on the downstream slope and crest could ultimately impair the stability of the dam, particularly in the areas where the crest width has been drastically reduced. The present spillway is seriously deficient in capacity and operational effectiveness. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- b. Adequacy of Information. Due to the lack of engineering data, the conclusions in this report are based upon performance history and visual observations. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. The items recommended in paragraph 7.2.a should be pursued on a very high priority basis.
- d. Necessity for Further Investigations. The additional studies and analyses recommended in paragraph 7.2 should be accomplished by the owner on a very high priority basis.
- e. Seismic Stability. This dam is located in Seismic Zone 1. Due to the poor condition of this dam, it is not known what effect an earthquake of this magnitude might have on the dam.

7.2 REMEDIAL MEASURES

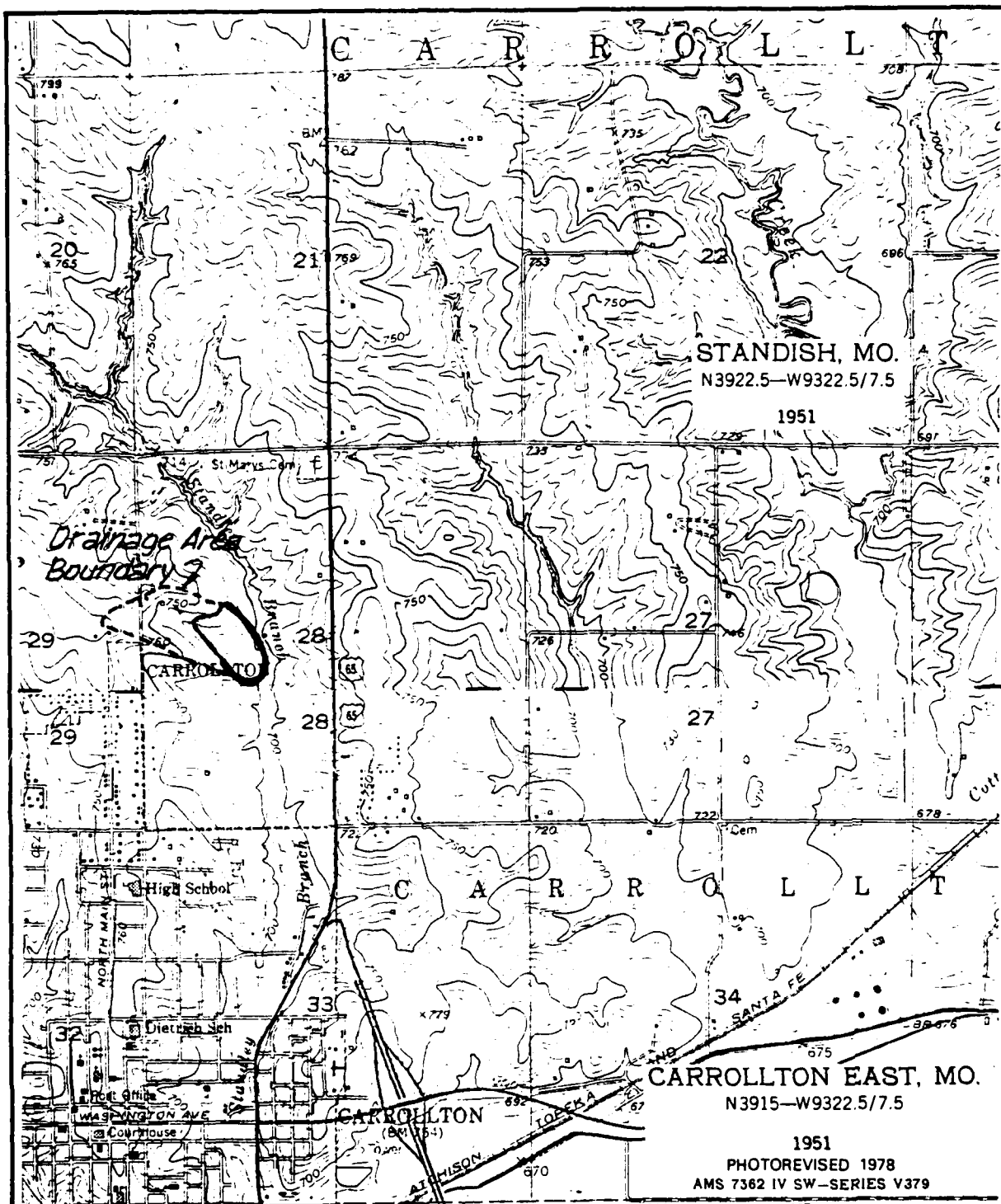
- a. Alternatives.
 - (1) Lower the water level in the lake to stop further erosional damage to the dam and to facilitate reconstruction, repairs and stabilization of the upstream slope and crest of the dam.
 - (2) Remove all trees and brush from the crest and downstream slope in preparation for repairs and reconstruction.
 - (3) Conduct seepage and stability analyses comparable to the requirements of the guidelines (including earthquake loads).

- (4) Increase the height of the dam and/or construct spillway(s) through the left or right (or both) abutments as necessary to pass the Probable Maximum Flood without overtopping the dam.
- (5) The services of an engineer experienced in the design and construction of earth dams should be obtained to provide guidance in lowering of the water level in the lake and in the removal of the trees and brush. In addition he should conduct seepage and stability analyses and should design remedial and protective measures as required.

b. Operation and Maintenance Procedures.

- (1) The existing dam is in such condition that problems normally considered as maintenance problems are magnified in scope and of necessity become major parts of the work necessary to rehabilitate the dam.
- (2) After rehabilitation work is completed a program of periodic inspection and regular maintenance to control wave erosion and tree growth should be initiated.
- (3) All records of inspection and maintenance operations should be made a part of this project file.

APPENDIX A
MAPS

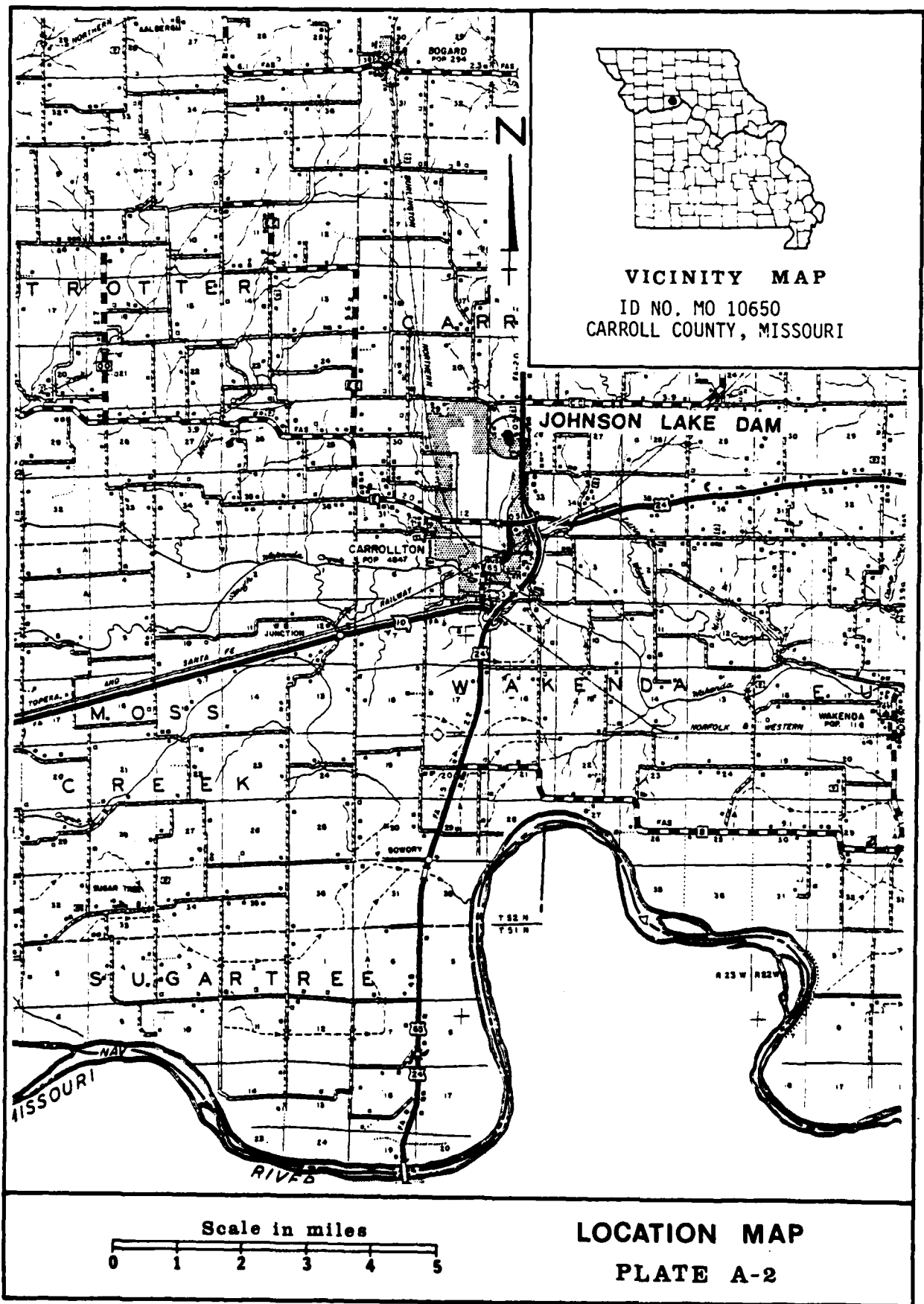


Scale in feet
2000 1000 0 2000 4000

Contour Interval - 10'



VICINITY TOPOGRAPHY
JOHNSON LAKE DAM
CARROLL COUNTY, MISSOURI
MO. 10650 PLATE A-1



APPENDIX B
PHOTOGRAPHS



JOHNSON LAKE DAM
CARROLL COUNTY, MISSOURI
MO 10650

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - UPSTREAM FACE OF LEFT LEG FROM LEFT END.



PHOTO NO. 3 - CREST OF LEFT LEG TAKEN FROM LEFT END.



PHOTO NO. 4 - CREST OF LEFT LEG TAKEN FROM RIGHT END.



PHOTO NO. 5 - CREST OF UPSTREAM FACE OF THE RIGHT LEG OF DAM.



PHOTO NO. 6 - CREST
WIDTH AT STA. 7+00
IT'S ABOUT 12-15 INCHES
WIDE. AUGER SET ON
CREST.

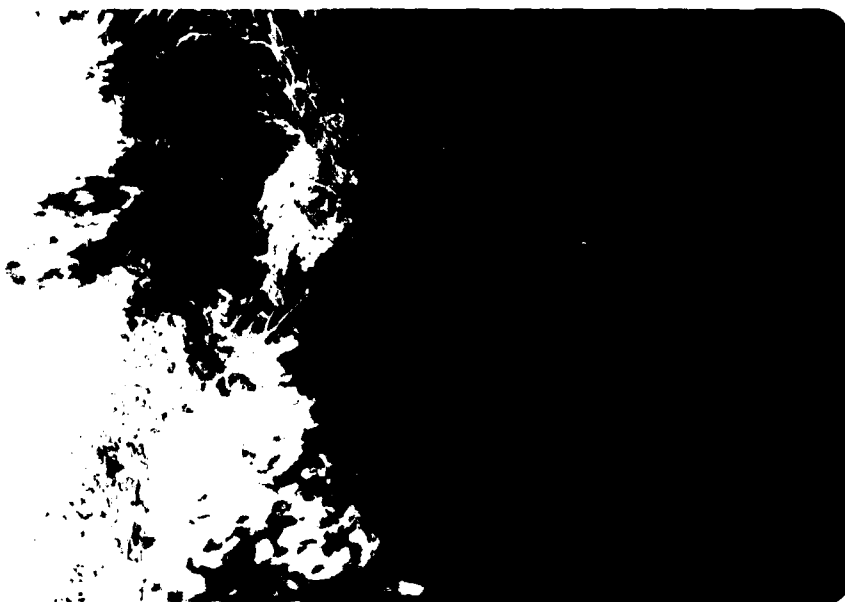


PHOTO NO. 7 - CREST AT ABOUT STA. 7+50. THERE IS A VERTICAL
FACE OF 2 1/2 FEET AND LESS THAN ONE FOOT OF MATERIAL BEFORE
STARTING DOWN DOWNSTREAM SLOPE.

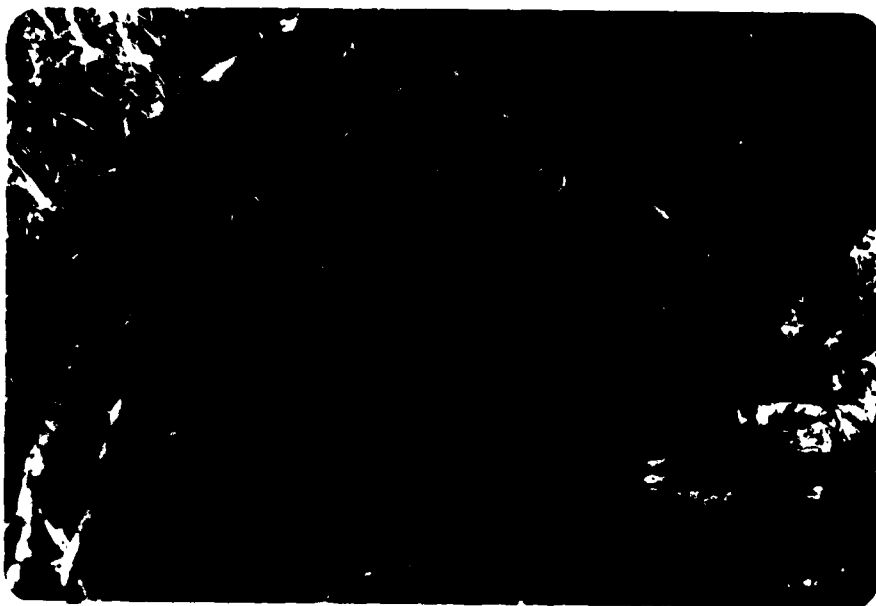


PHOTO NO. 8 - HOLE ERODED UNDER THE CREST AT STA. 8+20. IT'S ABOUT 12 INCHES BACK INTO SLOPE.

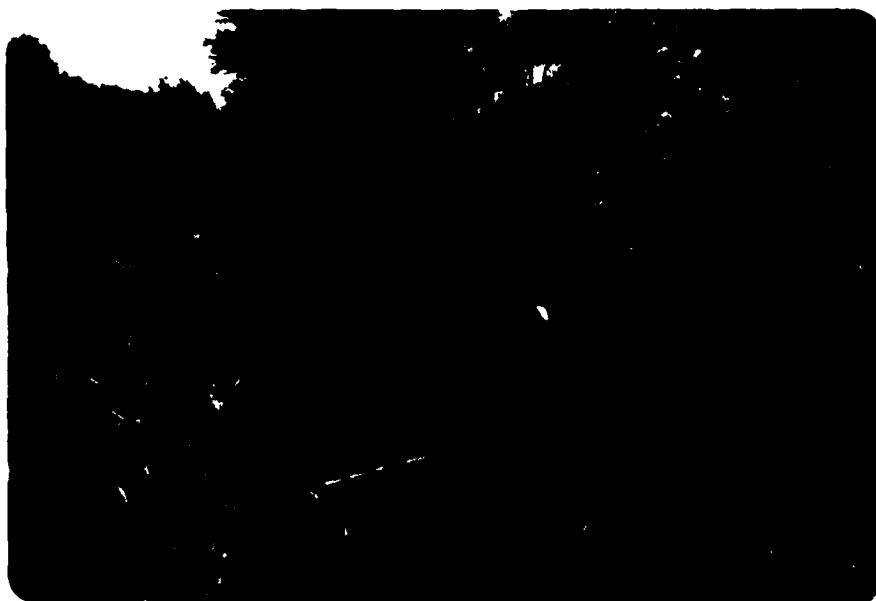


PHOTO NO. 9 - DOWNSTREAM SLOPE OF LEFT LEG.



PHOTO NO. 10 - LOOKING DOWNSTREAM AT MAXIMUM SECTION WHICH IS ABOUT STA. 5+50.

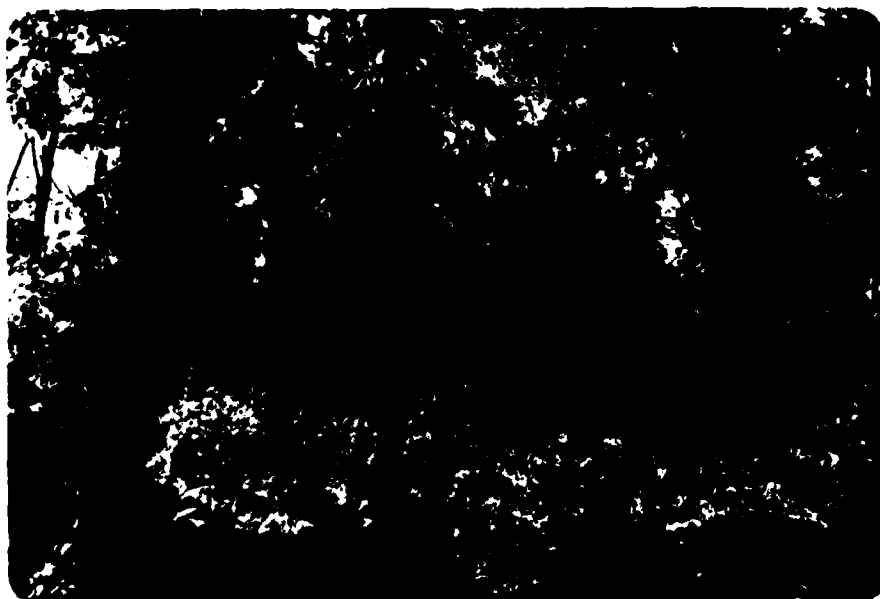


PHOTO NO. 11 - LOOKING UP DOWNSTREAM SLOPE AT ABOUT STA. 7+50.



PHOTO NO. 12 - DOWNSTREAM SLOPE OF THE RIGHT LEG ENTIRELY COVERED WITH BRUSH AND TREES.



PHOTO NO. 13 - SPILLWAY OF DAM. ABOUT A 4' CUT THROUGH THE CREST OF RIGHT LEG.



PHOTO NO. 14 - LOOKING UPSTREAM FROM STA. 5+50.



PHOTO NO. 15 - OVERVIEW



PHOTO NO. 16 - TWO COMMERCIAL BUILDINGS ABOUT ONE MILE DOWNSTREAM.
RED BARN IS 9' AND GRAY BUILDING IS 12' ABOVE FLOOD PLAIN.



PHOTO NO. 17 - HOUSES ABOUT 1-1/8 MILE DOWNSTREAM ABOUT 5' ABOVE
FLOOD PLAIN.

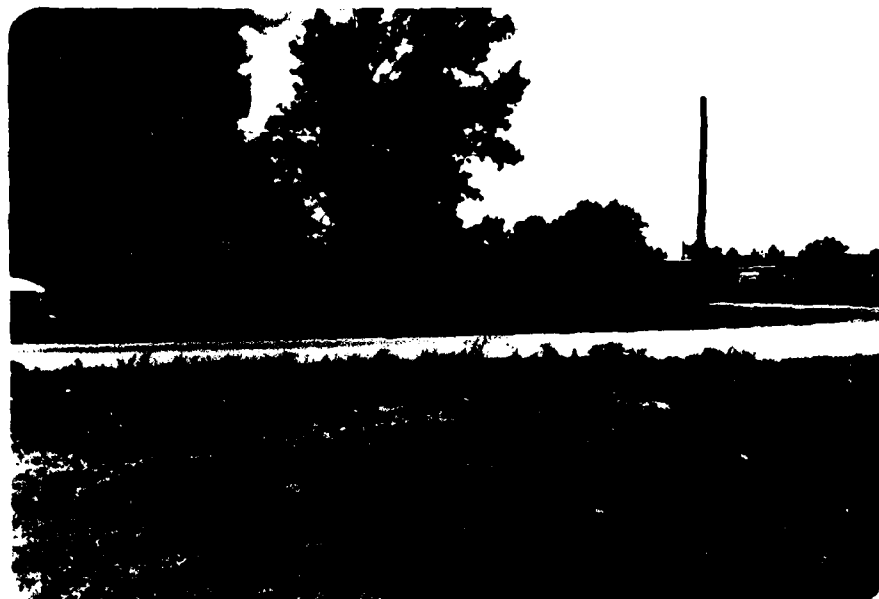
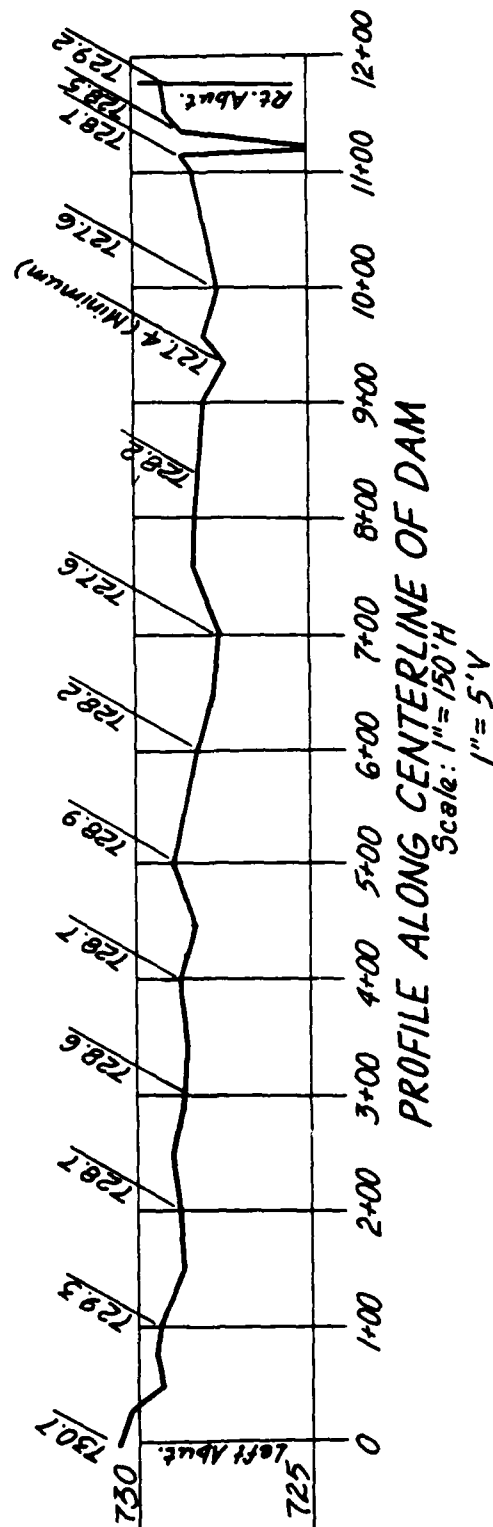
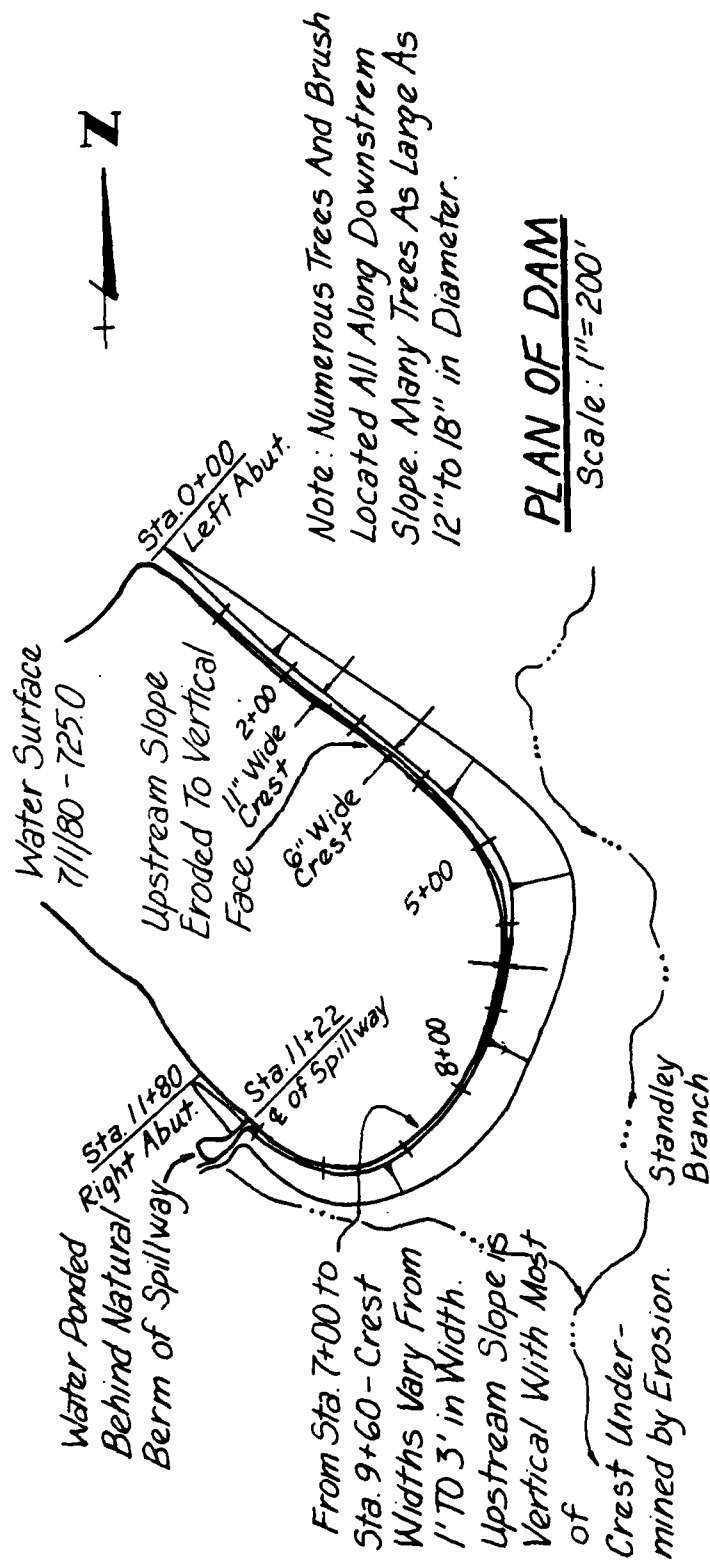


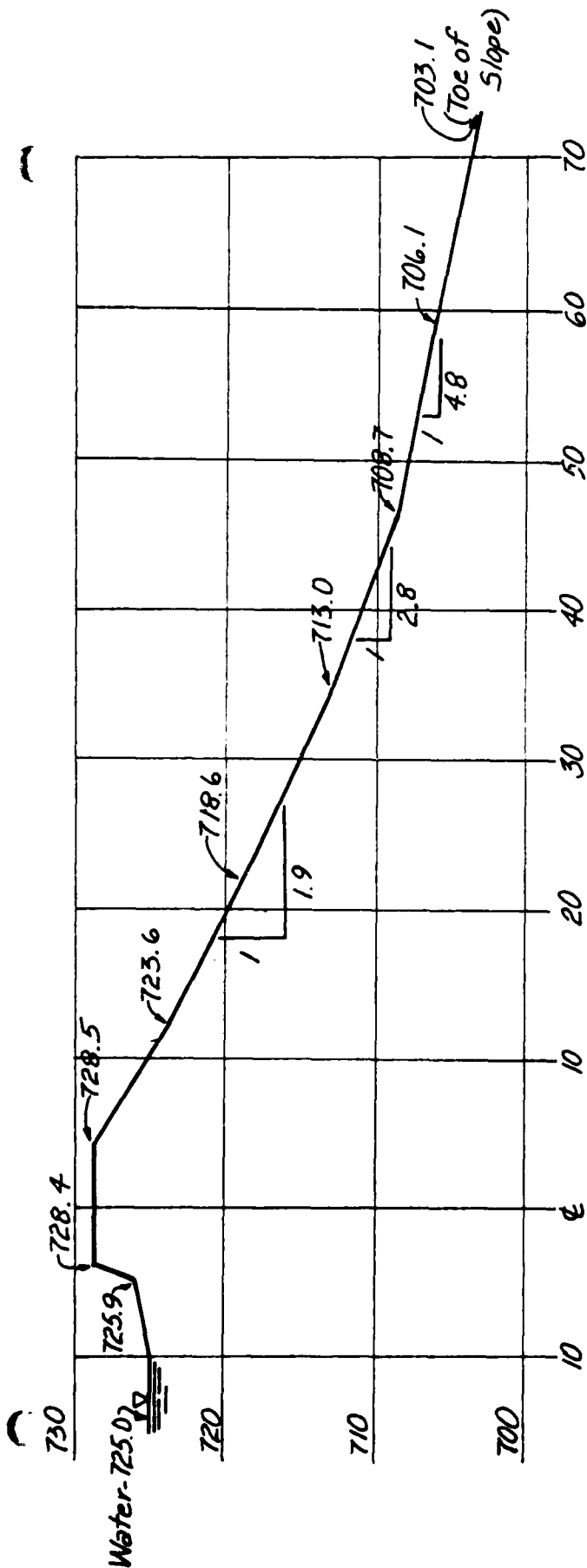
PHOTO NO. 18 - TRAILER HOUSE ABOUT 1-1/8 MILE DOWNSTREAM
ABOUT 5' ABOVE FLOOD PLAIN



PHOTO NO. 19 - NUMBER OF MOBILE HOMES IN FLOOD PLAIN.
TAKEN LOOKING UPSTREAM FROM BRIDGE ON HIGHWAY 65 IN CARROLLTON.

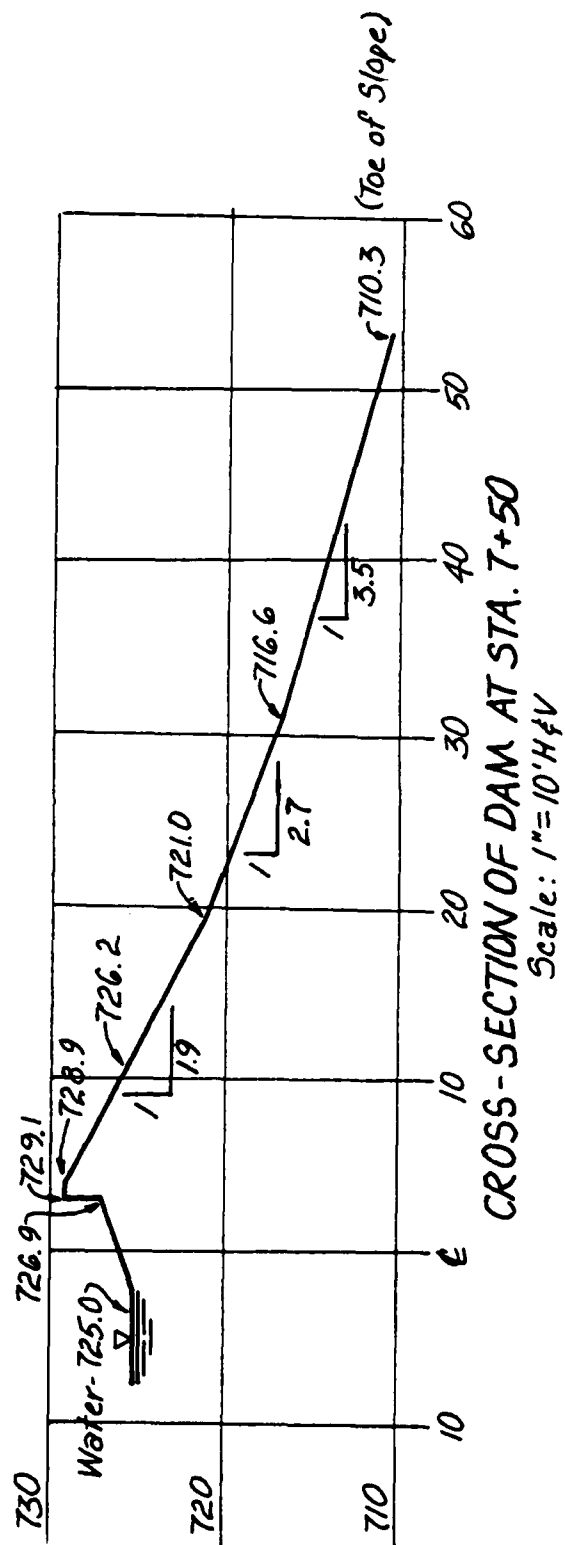
APPENDIX C
PROJECT PLATES





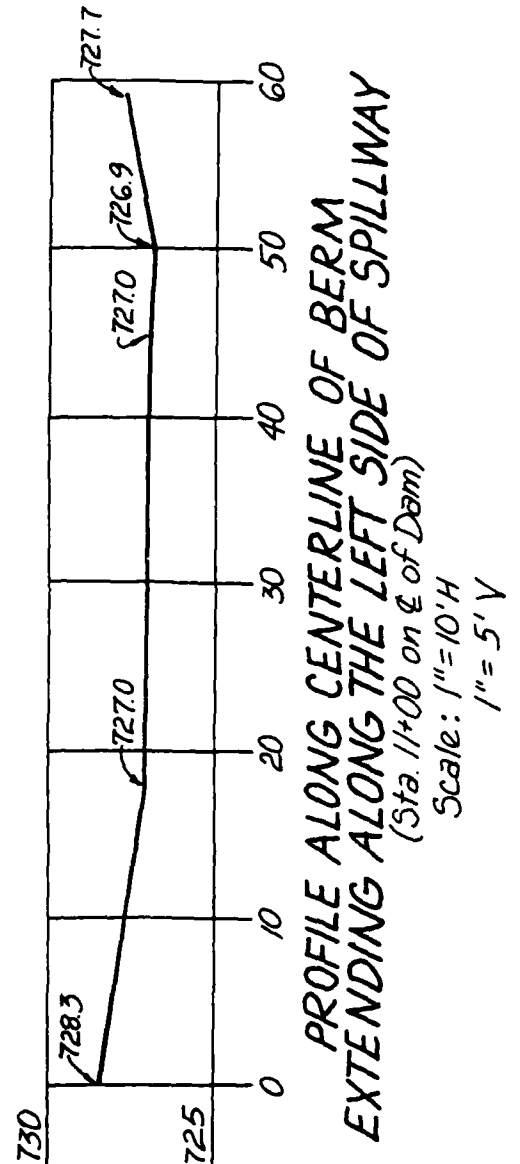
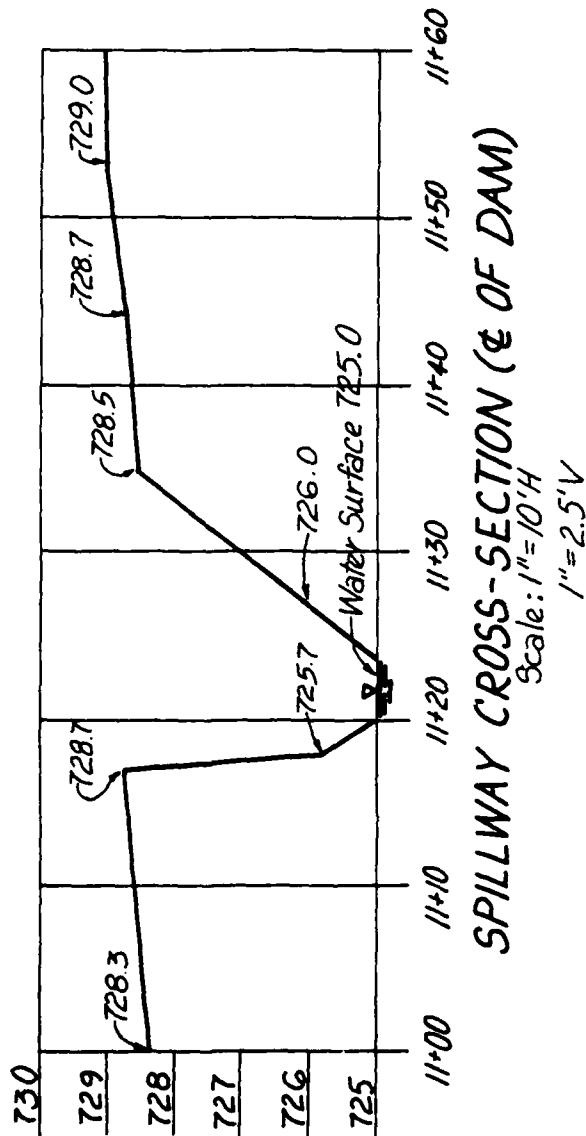
MAXIMUM CROSS-SECTION OF DAM AT STA. 5+70

Scale: 1" = 10' H & V



CROSS-SECTION OF DAM AT STA. 7+50

Scale: 1" = 10' H & V

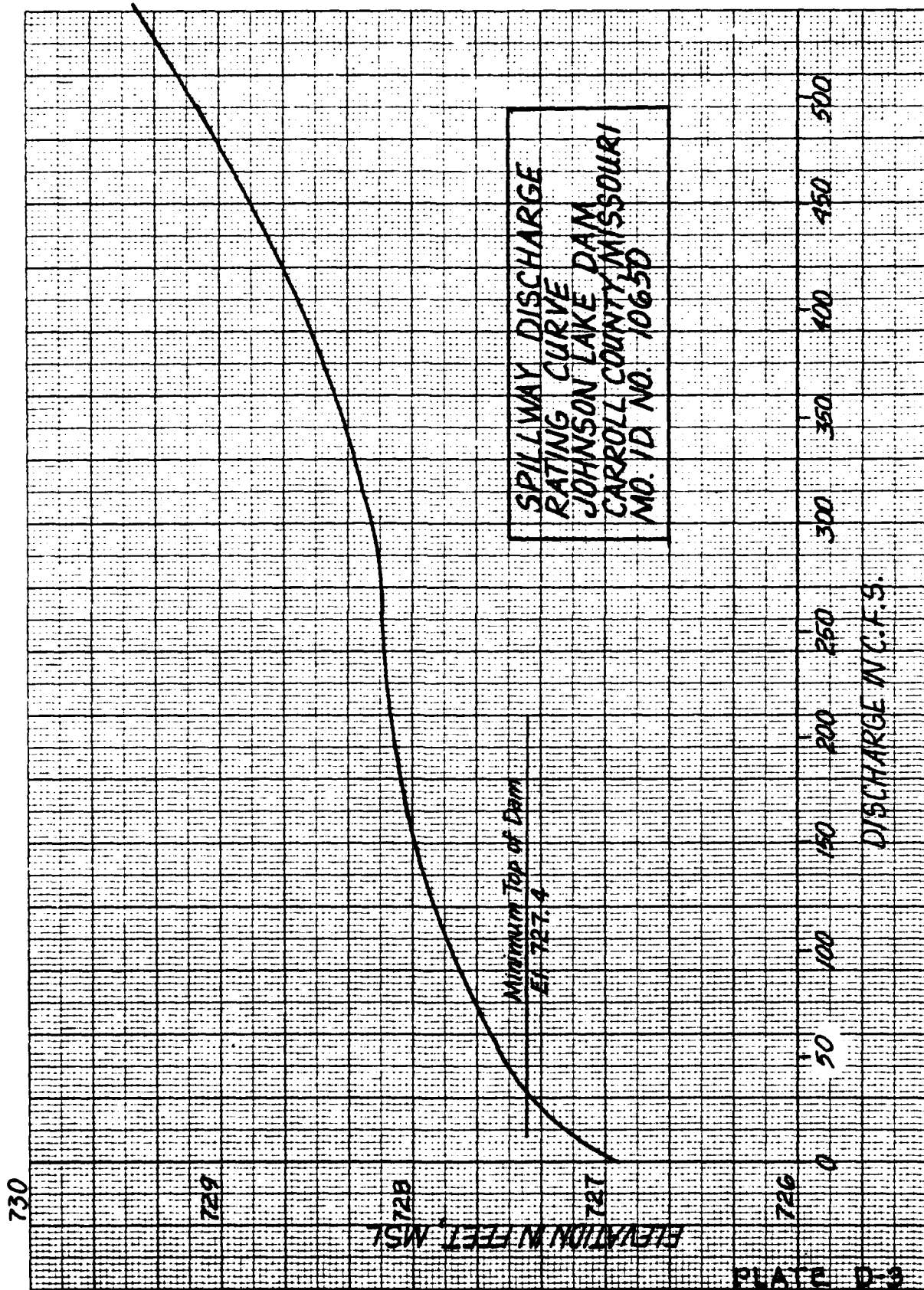


APPENDIX D
HYDRAULIC AND HYDROLOGIC DATA

HYDROLOGIC COMPUTATIONS

1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See this Section).
 - a. Twenty-four hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Sweet Springs, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The twenty-four probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
 - b. Drainage area = 0.047 square miles (30 acres).
 - c. Time of concentration of runoff = 12 minutes (computed from the "Kirpich" formula.)
 - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the crest of the spillway.
 - e. The total twenty-four hour storm duration losses for the one percent probabilistic storm were 1.77 inches. The total losses for the PMF storm were 0.75 inches. These data are based on SCS runoff curve No. 94 and No. 85 for antecedent moisture conditions SCS AMC III and AMC II respectively. The watershed is composed of primarily SCS soil group C (Grundy Soil Series). 21 acres of the watershed consists of pasture; 3 acres consists of paved road and parking lots; and 6 acres consists of the surface area of the reservoir.
 - f. Average soil loss rates = 0.03 inch per hour approximately. (for PMF storm, AMC III).
2. The combined discharge rating consisted of two components: the flow through the spillway and the flow going over the top of the dam.
 - a. The spillway rating was developed using the Corps of Engineers Water Surface Profile HEC-2 computer program assuming critical depth at the downstream section.
 - b. The flows over the dam were determined by using the irregular top of dam option within the HEC-1 (Dam Safety Version) program.

3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The input, output and plotted hydrographs are exhibited in this Section.



| | |
|-----|---|
| A1 | ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF |
| A2 | H & H ANALYSIS OF SAFETY OF JOHNSON LAKE DAM 10650 |
| A3 | RATIOS OF PMF ROUTED THROUGH THE RESERVOIR |
| B | 0002880000000000000005 00000000000000000000003 |
| B1 | 000005 |
| J | 00000100000009000000001 |
| JJ | 1000.100000.150000.200000.250000.300000.350000.400000.500000.1.00 |
| K | 0000000000000001 000000000000000000000001 |
| KK1 | CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 10650 |
| M | 0000010000002000.047 0000.047000001.0 00000001 |
| P | 00000000024.5000001020000012100000130 |
| T | |
| W2 | 00000.17 |
| X | 000000 - .01000000001 |
| K | 000001000000002 000000020000000000000001 |
| K1 | ROUTED FLOWS THROUGH RESERVOIR 10650 |
| Y | 00000001000000001 |
| Y1 | 0000001 |
| Y4 | 0726.9000727.1000727.5000727.8000728.1000729.2 -1 |
| Y5 | 00000000000010000000500000010000000250000000500 |
| \$A | 000000000002.1000005.7000008.5 |
| \$E | 0703.5000716.0000725.0000730.0 |
| \$S | 0726.9 |
| \$D | 0727.4000002.9000001.500001180 |
| \$L | 0000000000011000000185000005150000085000001030000001125000001130000001195 |
| \$V | 0727.4000727.7000727.9000728.3000728.7000729.1000729.5000730.2000731.0 |
| K | 000099 |
| A | |
| A | |
| A | |
| A | |
| A | |
| A | |

 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 26 FEB 79

RUN DATE# 80/07/30.
 TIME# 16.38.15.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 H & H ANALYSIS OF SAFETY OF JOHNSON LAKE DAM 10650
 RATIOS OF PMF ROUTED THROUGH THE RESERVOIR

| JOB SPECIFICATION | | | | | | | | | |
|-------------------|-------|------|-------|-------|------|-------|------|------|-------|
| NO | NHR | NMIN | IDAY | IHR | IMIN | METRC | IPLT | IPRT | NSTAN |
| 268 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 3 | 0 |
| | JOPER | NMT | LROPT | TRACE | | | | | |
| | 5 | 0 | 0 | 0 | | | | | |

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 9 LRTIO= 1

| RATIOS= | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .50 | 1.00 |
|---------|-----|-----|-----|-----|-----|-----|-----|-----|------|
|---------|-----|-----|-----|-----|-----|-----|-----|-----|------|

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDROGRAPH TO RESERVOIR 10650

| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | IAUTO |
|--------|-------|-------|-------|------|------|-------|--------|-------|
| 000001 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |

| HYDROGRAPH DATA | | | |
|-----------------|------|-------|------|
| IHYOG | IUNG | TAREA | SNAP |
| 1 | 2 | .05 | 0.00 |

| PRECIP DATA | | | |
|-------------|-------|--------|--------|
| SPFE | PMS | R6 | R24 |
| 0.00 | 24.50 | 102.00 | 121.00 |

| LOSS DATA | | | |
|-----------|------|-------|-------|
| LROPT | STKR | DLTKR | RTIOL |
| 0 | 0.00 | 0.00 | 1.00 |

CURVE NO = -94.00 WETNESS = -1.00 EFFECT CN = 94.00

UNIT HYDROGRAPH DATA
 TC= 0.00 LAG= .17

RECESSION DATA
 STKTO= 0.00 ORCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 12 END OF PERIOD ORIGINATES. TC= 0.00 HOURS, LAG= .17 VOL= 1.00
 33. 99. 101. 32. 17. 9. 5. 3. 1.

END-OF-PERIOD FLOW

| MO.DA | HR.MN | PERIOD | MAIN | EXCS | LOSS | COMP U | MO.DA | HR.MN | PERIOD | RAIN | EXCS | LOSS | COMP U |
|-------|-------|--------|------|------|------|--------|-------|-------|--------|------|------|------|--------|
| 1.01 | .05 | 1 | .01 | 0.00 | .01 | 0. | 1.01 | 12.05 | 145 | .21 | .21 | .00 | 28. |
| 1.01 | .10 | 2 | .01 | 0.00 | .01 | 0. | 1.01 | 12.10 | 146 | .21 | .21 | .00 | 42. |
| 1.01 | .15 | 3 | .01 | 0.00 | .01 | 0. | 1.01 | 12.15 | 147 | .21 | .21 | .00 | 56. |
| 1.01 | .20 | 4 | .01 | 0.00 | .01 | 0. | 1.01 | 12.20 | 148 | .21 | .21 | .00 | 65. |
| 1.01 | .25 | 5 | .01 | 0.00 | .01 | 0. | 1.01 | 12.25 | 149 | .21 | .21 | .00 | 70. |
| 1.01 | .30 | 6 | .01 | 0.00 | .01 | 0. | 1.01 | 12.30 | 150 | .21 | .21 | .00 | 72. |
| 1.01 | .35 | 7 | .01 | 0.00 | .01 | 0. | 1.01 | 12.35 | 151 | .21 | .21 | .00 | 74. |
| 1.01 | .40 | 8 | .01 | 0.00 | .01 | 0. | 1.01 | 12.40 | 152 | .21 | .21 | .00 | 74. |
| 1.01 | .45 | 9 | .01 | 0.00 | .01 | 0. | 1.01 | 12.45 | 153 | .21 | .21 | .00 | 75. |
| 1.01 | .50 | 10 | .01 | 0.00 | .01 | 0. | 1.01 | 12.50 | 154 | .21 | .21 | .00 | 75. |
| 1.01 | .55 | 11 | .01 | 0.00 | .01 | 0. | 1.01 | 12.55 | 155 | .21 | .21 | .00 | 75. |
| 1.01 | 1.00 | 12 | .01 | 0.00 | .01 | 0. | 1.01 | 13.00 | 156 | .21 | .21 | .00 | 75. |
| 1.01 | 1.05 | 13 | .01 | 0.00 | .01 | 0. | 1.01 | 13.05 | 157 | .25 | .25 | .00 | 77. |
| 1.01 | 1.10 | 14 | .01 | 0.00 | .01 | 0. | 1.01 | 13.10 | 158 | .25 | .25 | .00 | 81. |
| 1.01 | 1.15 | 15 | .01 | 0.00 | .01 | 0. | 1.01 | 13.15 | 159 | .25 | .25 | .00 | 85. |
| 1.01 | 1.20 | 16 | .01 | 0.00 | .01 | 0. | 1.01 | 13.20 | 160 | .25 | .25 | .00 | 88. |
| 1.01 | 1.25 | 17 | .01 | 0.00 | .01 | 1. | 1.01 | 13.25 | 161 | .25 | .25 | .00 | 89. |
| 1.01 | 1.30 | 18 | .01 | 0.00 | .01 | 1. | 1.01 | 13.30 | 162 | .25 | .25 | .00 | 90. |
| 1.01 | 1.35 | 19 | .01 | 0.00 | .01 | 1. | 1.01 | 13.35 | 163 | .25 | .25 | .00 | 90. |
| 1.01 | 1.40 | 20 | .01 | 0.00 | .01 | 1. | 1.01 | 13.40 | 164 | .25 | .25 | .00 | 90. |
| 1.01 | 1.45 | 21 | .01 | 0.00 | .01 | 1. | 1.01 | 13.45 | 165 | .25 | .25 | .00 | 90. |
| 1.01 | 1.50 | 22 | .01 | 0.00 | .01 | 1. | 1.01 | 13.50 | 166 | .25 | .25 | .00 | 91. |
| 1.01 | 1.55 | 23 | .01 | 0.00 | .01 | 1. | 1.01 | 13.55 | 167 | .25 | .25 | .00 | 91. |
| 1.01 | 2.00 | 24 | .01 | 0.00 | .01 | 1. | 1.01 | 14.00 | 168 | .25 | .25 | .00 | 91. |
| 1.01 | 2.05 | 25 | .01 | 0.00 | .01 | 1. | 1.01 | 14.05 | 169 | .31 | .31 | .00 | 93. |
| 1.01 | 2.10 | 26 | .01 | 0.00 | .01 | 2. | 1.01 | 14.10 | 170 | .31 | .31 | .00 | 99. |
| 1.01 | 2.15 | 27 | .01 | .01 | .01 | 2. | 1.01 | 14.15 | 171 | .31 | .31 | .00 | 105. |
| 1.01 | 2.20 | 28 | .01 | .01 | .01 | 2. | 1.01 | 14.20 | 172 | .31 | .31 | .00 | 109. |
| 1.01 | 2.25 | 29 | .01 | .01 | .01 | 2. | 1.01 | 14.25 | 173 | .31 | .31 | .00 | 111. |
| 1.01 | 2.30 | 30 | .01 | .01 | .01 | 2. | 1.01 | 14.30 | 174 | .31 | .31 | .00 | 112. |
| 1.01 | 2.35 | 31 | .01 | .01 | .01 | 2. | 1.01 | 14.35 | 175 | .31 | .31 | .00 | 113. |
| 1.01 | 2.40 | 32 | .01 | .01 | .01 | 2. | 1.01 | 14.40 | 176 | .31 | .31 | .00 | 113. |
| 1.01 | 2.45 | 33 | .01 | .01 | .01 | 2. | 1.01 | 14.45 | 177 | .31 | .31 | .00 | 113. |
| 1.01 | 2.50 | 34 | .01 | .01 | .01 | 2. | 1.01 | 14.50 | 178 | .31 | .31 | .00 | 113. |
| 1.01 | 2.55 | 35 | .01 | .01 | .01 | 2. | 1.01 | 14.55 | 179 | .31 | .31 | .00 | 113. |
| 1.01 | 3.00 | 36 | .01 | .01 | .01 | 2. | 1.01 | 15.00 | 180 | .31 | .31 | .00 | 113. |
| 1.01 | 3.05 | 37 | .01 | .01 | .01 | 2. | 1.01 | 15.05 | 181 | .19 | .19 | .00 | 109. |
| 1.01 | 3.10 | 38 | .01 | .01 | .01 | 2. | 1.01 | 15.10 | 182 | .38 | .38 | .00 | 104. |
| 1.01 | 3.15 | 39 | .01 | .01 | .01 | 2. | 1.01 | 15.15 | 183 | .38 | .38 | .00 | 110. |
| 1.01 | 3.20 | 40 | .01 | .01 | .01 | 3. | 1.01 | 15.20 | 184 | .57 | .57 | .00 | 128. |
| 1.01 | 3.25 | 41 | .01 | .01 | .00 | 3. | 1.01 | 15.25 | 185 | .66 | .66 | .00 | 158. |
| 1.01 | 3.30 | 42 | .01 | .01 | .00 | 3. | 1.01 | 15.30 | 186 | 1.61 | 1.61 | .00 | 221. |
| 1.01 | 3.35 | 43 | .01 | .01 | .00 | 3. | 1.01 | 15.35 | 187 | 2.66 | 2.66 | .00 | 372. |
| 1.01 | 3.40 | 44 | .01 | .01 | .00 | 3. | 1.01 | 15.40 | 188 | 1.04 | 1.04 | .00 | 532. |
| 1.01 | 3.45 | 45 | .01 | .01 | .00 | 3. | 1.01 | 15.45 | 189 | .66 | .66 | .00 | 534. |
| 1.01 | 3.50 | 46 | .01 | .01 | .00 | 3. | 1.01 | 15.50 | 190 | .57 | .57 | .00 | 430. |
| 1.01 | 3.55 | 47 | .01 | .01 | .00 | 3. | 1.01 | 15.55 | 191 | .38 | .38 | .00 | 325. |
| 1.01 | 4.00 | 48 | .01 | .01 | .00 | 3. | 1.01 | 16.00 | 192 | .38 | .38 | .00 | 248. |
| 1.01 | 4.05 | 49 | .01 | .01 | .00 | 3. | 1.01 | 16.05 | 193 | .29 | .29 | .00 | 195. |
| 1.01 | 4.10 | 50 | .01 | .01 | .00 | 3. | 1.01 | 16.10 | 194 | .29 | .29 | .00 | 158. |
| 1.01 | 4.15 | 51 | .01 | .01 | .00 | 3. | 1.01 | 16.15 | 195 | .29 | .29 | .00 | 134. |
| 1.01 | 4.20 | 52 | .01 | .01 | .00 | 3. | 1.01 | 16.20 | 196 | .29 | .29 | .00 | 121. |
| 1.01 | 4.25 | 53 | .01 | .01 | .00 | 3. | 1.01 | 16.25 | 197 | .29 | .29 | .00 | 114. |
| 1.01 | 4.30 | 54 | .01 | .01 | .00 | 3. | 1.01 | 16.30 | 198 | .29 | .29 | .00 | 110. |
| 1.01 | 4.35 | 55 | .01 | .01 | .00 | 3. | 1.01 | 16.35 | 199 | .29 | .29 | .00 | 108. |
| 1.01 | 4.40 | 56 | .01 | .01 | .00 | 3. | 1.01 | 16.40 | 200 | .29 | .29 | .00 | 107. |
| 1.01 | 4.45 | 57 | .01 | .01 | .00 | 3. | 1.01 | 16.45 | 201 | .29 | .29 | .00 | 106. |
| 1.01 | 4.50 | 58 | .01 | .01 | .00 | 3. | 1.01 | 16.50 | 202 | .29 | .29 | .00 | 106. |
| 1.01 | 4.55 | 59 | .01 | .01 | .00 | 3. | 1.01 | 16.55 | 203 | .29 | .29 | .00 | 106. |
| 1.01 | 5.00 | 60 | .01 | .01 | .00 | 3. | 1.01 | 17.00 | 204 | .29 | .29 | .00 | 106. |

| | | | | | | | | | | | | | |
|------|-------|-----|-----|-----|-----|-----|------|-------|-----|-----|-----|-----|------|
| 1.01 | 5.05 | 61 | .01 | .01 | .00 | 3. | 1.01 | 17.05 | 205 | .23 | .23 | .00 | 104. |
| 1.01 | 5.10 | 62 | .01 | .01 | .00 | 3. | 1.01 | 17.10 | 206 | .23 | .23 | .00 | 98. |
| 1.01 | 5.15 | 63 | .01 | .01 | .00 | 3. | 1.01 | 17.15 | 207 | .23 | .23 | .00 | 91. |
| 1.01 | 5.20 | 64 | .01 | .01 | .00 | 3. | 1.01 | 17.20 | 208 | .23 | .23 | .00 | 88. |
| 1.01 | 5.25 | 65 | .01 | .01 | .00 | 3. | 1.01 | 17.25 | 209 | .23 | .23 | .00 | 86. |
| 1.01 | 5.30 | 66 | .01 | .01 | .00 | 3. | 1.01 | 17.30 | 210 | .23 | .23 | .00 | 84. |
| 1.01 | 5.35 | 67 | .01 | .01 | .00 | 3. | 1.01 | 17.35 | 211 | .23 | .23 | .00 | 84. |
| 1.01 | 5.40 | 68 | .01 | .01 | .00 | 3. | 1.01 | 17.40 | 212 | .23 | .23 | .00 | 84. |
| 1.01 | 5.45 | 69 | .01 | .01 | .00 | 3. | 1.01 | 17.45 | 213 | .23 | .23 | .00 | 83. |
| 1.01 | 5.50 | 70 | .01 | .01 | .00 | 3. | 1.01 | 17.50 | 214 | .23 | .23 | .00 | 83. |
| 1.01 | 5.55 | 71 | .01 | .01 | .00 | 3. | 1.01 | 17.55 | 215 | .23 | .23 | .00 | 83. |
| 1.01 | 6.00 | 72 | .01 | .01 | .00 | 3. | 1.01 | 18.00 | 216 | .23 | .23 | .00 | 83. |
| 1.01 | 6.05 | 73 | .06 | .05 | .01 | 5. | 1.01 | 18.05 | 217 | .02 | .02 | .00 | 76. |
| 1.01 | 6.10 | 74 | .06 | .05 | .01 | 9. | 1.01 | 18.10 | 218 | .02 | .02 | .00 | 56. |
| 1.01 | 6.15 | 75 | .06 | .05 | .01 | 13. | 1.01 | 18.15 | 219 | .02 | .02 | .00 | 34. |
| 1.01 | 6.20 | 76 | .06 | .05 | .01 | 16. | 1.01 | 18.20 | 220 | .02 | .02 | .00 | 21. |
| 1.01 | 6.25 | 77 | .06 | .06 | .01 | 18. | 1.01 | 18.25 | 221 | .02 | .02 | .00 | 14. |
| 1.01 | 6.30 | 78 | .06 | .06 | .01 | 19. | 1.01 | 18.30 | 222 | .02 | .02 | .00 | 11. |
| 1.01 | 6.35 | 79 | .06 | .06 | .01 | 20. | 1.01 | 18.35 | 223 | .02 | .02 | .00 | 9. |
| 1.01 | 6.40 | 80 | .06 | .06 | .01 | 20. | 1.01 | 18.40 | 224 | .02 | .02 | .00 | 8. |
| 1.01 | 6.45 | 81 | .06 | .06 | .01 | 20. | 1.01 | 18.45 | 225 | .02 | .02 | .00 | 7. |
| 1.01 | 6.50 | 82 | .06 | .06 | .01 | 21. | 1.01 | 18.50 | 226 | .02 | .02 | .00 | 7. |
| 1.01 | 6.55 | 83 | .06 | .06 | .01 | 21. | 1.01 | 18.55 | 227 | .02 | .02 | .00 | 7. |
| 1.01 | 7.00 | 84 | .06 | .06 | .01 | 21. | 1.01 | 19.00 | 228 | .02 | .02 | .00 | 7. |
| 1.01 | 7.05 | 85 | .06 | .06 | .01 | 21. | 1.01 | 19.05 | 229 | .02 | .02 | .00 | 7. |
| 1.01 | 7.10 | 86 | .06 | .06 | .01 | 21. | 1.01 | 19.10 | 230 | .02 | .02 | .00 | 7. |
| 1.01 | 7.15 | 87 | .06 | .06 | .00 | 21. | 1.01 | 19.15 | 231 | .02 | .02 | .00 | 7. |
| 1.01 | 7.20 | 88 | .06 | .06 | .00 | 22. | 1.01 | 19.20 | 232 | .02 | .02 | .00 | 7. |
| 1.01 | 7.25 | 89 | .06 | .06 | .00 | 22. | 1.01 | 19.25 | 233 | .02 | .02 | .00 | 7. |
| 1.01 | 7.30 | 90 | .06 | .06 | .00 | 22. | 1.01 | 19.30 | 234 | .02 | .02 | .00 | 7. |
| 1.01 | 7.35 | 91 | .06 | .06 | .00 | 22. | 1.01 | 19.35 | 235 | .02 | .02 | .00 | 7. |
| 1.01 | 7.40 | 92 | .06 | .06 | .00 | 22. | 1.01 | 19.40 | 236 | .02 | .02 | .00 | 7. |
| 1.01 | 7.45 | 93 | .06 | .06 | .00 | 22. | 1.01 | 19.45 | 237 | .02 | .02 | .00 | 7. |
| 1.01 | 7.50 | 94 | .06 | .06 | .00 | 22. | 1.01 | 19.50 | 238 | .02 | .02 | .00 | 7. |
| 1.01 | 7.55 | 95 | .06 | .06 | .00 | 22. | 1.01 | 19.55 | 239 | .02 | .02 | .00 | 7. |
| 1.01 | 8.00 | 96 | .06 | .06 | .00 | 22. | 1.01 | 20.00 | 240 | .02 | .02 | .00 | 7. |
| 1.01 | 8.05 | 97 | .06 | .06 | .00 | 22. | 1.01 | 20.05 | 241 | .02 | .02 | .00 | 7. |
| 1.01 | 8.10 | 98 | .06 | .06 | .00 | 22. | 1.01 | 20.10 | 242 | .02 | .02 | .00 | 7. |
| 1.01 | 8.15 | 99 | .06 | .06 | .00 | 22. | 1.01 | 20.15 | 243 | .02 | .02 | .00 | 7. |
| 1.01 | 8.20 | 100 | .06 | .06 | .00 | 22. | 1.01 | 20.20 | 244 | .02 | .02 | .00 | 7. |
| 1.01 | 8.25 | 101 | .06 | .06 | .00 | 23. | 1.01 | 20.25 | 245 | .02 | .02 | .00 | 7. |
| 1.01 | 8.30 | 102 | .06 | .06 | .00 | 23. | 1.01 | 20.30 | 246 | .02 | .02 | .00 | 7. |
| 1.01 | 8.35 | 103 | .06 | .06 | .00 | 23. | 1.01 | 20.35 | 247 | .02 | .02 | .00 | 7. |
| 1.01 | 8.40 | 104 | .06 | .06 | .00 | 23. | 1.01 | 20.40 | 248 | .02 | .02 | .00 | 7. |
| 1.01 | 8.45 | 105 | .06 | .06 | .00 | 23. | 1.01 | 20.45 | 249 | .02 | .02 | .00 | 7. |
| 1.01 | 8.50 | 106 | .06 | .06 | .00 | 23. | 1.01 | 20.50 | 250 | .02 | .02 | .00 | 7. |
| 1.01 | 8.55 | 107 | .06 | .06 | .00 | 23. | 1.01 | 20.55 | 251 | .02 | .02 | .00 | 7. |
| 1.01 | 9.00 | 108 | .06 | .06 | .00 | 23. | 1.01 | 21.00 | 252 | .02 | .02 | .00 | 7. |
| 1.01 | 9.05 | 109 | .06 | .06 | .00 | 23. | 1.01 | 21.05 | 253 | .02 | .02 | .00 | 7. |
| 1.01 | 9.10 | 110 | .06 | .06 | .00 | 23. | 1.01 | 21.10 | 254 | .02 | .02 | .00 | 7. |
| 1.01 | 9.15 | 111 | .06 | .06 | .00 | 23. | 1.01 | 21.15 | 255 | .02 | .02 | .00 | 7. |
| 1.01 | 9.20 | 112 | .06 | .06 | .00 | 23. | 1.01 | 21.20 | 256 | .02 | .02 | .00 | 7. |
| 1.01 | 9.25 | 113 | .06 | .06 | .00 | 23. | 1.01 | 21.25 | 257 | .02 | .02 | .00 | 7. |
| 1.01 | 9.30 | 114 | .06 | .06 | .00 | 23. | 1.01 | 21.30 | 258 | .02 | .02 | .00 | 7. |
| 1.01 | 9.35 | 115 | .06 | .06 | .00 | 23. | 1.01 | 21.35 | 259 | .02 | .02 | .00 | 7. |
| 1.01 | 9.40 | 116 | .06 | .06 | .00 | 23. | 1.01 | 21.40 | 260 | .02 | .02 | .00 | 7. |
| 1.01 | 9.45 | 117 | .06 | .06 | .00 | 23. | 1.01 | 21.45 | 261 | .02 | .02 | .00 | 7. |
| 1.01 | 9.50 | 118 | .06 | .06 | .00 | 23. | 1.01 | 21.50 | 262 | .02 | .02 | .00 | 7. |
| 1.01 | 9.55 | 119 | .06 | .06 | .00 | 23. | 1.01 | 21.55 | 263 | .02 | .02 | .00 | 7. |
| 1.01 | 10.00 | 120 | .06 | .06 | .00 | 23. | 1.01 | 22.00 | 264 | .02 | .02 | .00 | 7. |
| 1.01 | 10.05 | 121 | .06 | .06 | .00 | 23. | 1.01 | 22.05 | 265 | .02 | .02 | .00 | 7. |
| 1.01 | 10.10 | 122 | .06 | .06 | .00 | 23. | 1.01 | 22.10 | 266 | .02 | .02 | .00 | 7. |

| | | | | | | | | | | | |
|------------------------------------|-------|-----|-----|-----|-----|------|-------|-----|-----|-----|----|
| 1.01 | 10.15 | .06 | .06 | .00 | 23. | 1.01 | 22.15 | .02 | .02 | .00 | 7. |
| 1.01 | 10.20 | .06 | .06 | .00 | 23. | 1.01 | 22.20 | .02 | .02 | .00 | 7. |
| 1.01 | 10.25 | .06 | .06 | .00 | 23. | 1.01 | 22.25 | .02 | .02 | .00 | 7. |
| 1.01 | 10.30 | .06 | .06 | .00 | 23. | 1.01 | 22.30 | .02 | .02 | .00 | 7. |
| 1.01 | 10.35 | .06 | .06 | .00 | 23. | 1.01 | 22.35 | .02 | .02 | .00 | 7. |
| 1.01 | 10.40 | .06 | .06 | .00 | 23. | 1.01 | 22.40 | .02 | .02 | .00 | 7. |
| 1.01 | 10.45 | .06 | .06 | .00 | 23. | 1.01 | 22.45 | .02 | .02 | .00 | 7. |
| 1.01 | 10.50 | .06 | .06 | .00 | 23. | 1.01 | 22.50 | .02 | .02 | .00 | 7. |
| 1.01 | 10.55 | .06 | .06 | .00 | 23. | 1.01 | 22.55 | .02 | .02 | .00 | 7. |
| 1.01 | 11.00 | .06 | .06 | .00 | 23. | 1.01 | 23.00 | .02 | .02 | .00 | 7. |
| 1.01 | 11.05 | .06 | .06 | .00 | 23. | 1.01 | 23.05 | .02 | .02 | .00 | 7. |
| 1.01 | 11.10 | .06 | .06 | .00 | 23. | 1.01 | 23.10 | .02 | .02 | .00 | 7. |
| 1.01 | 11.15 | .06 | .06 | .00 | 23. | 1.01 | 23.15 | .02 | .02 | .00 | 7. |
| 1.01 | 11.20 | .06 | .06 | .00 | 23. | 1.01 | 23.20 | .02 | .02 | .00 | 7. |
| 1.01 | 11.25 | .06 | .06 | .00 | 23. | 1.01 | 23.25 | .02 | .02 | .00 | 7. |
| 1.01 | 11.30 | .06 | .06 | .00 | 23. | 1.01 | 23.30 | .02 | .02 | .00 | 7. |
| 1.01 | 11.35 | .06 | .06 | .00 | 23. | 1.01 | 23.35 | .02 | .02 | .00 | 7. |
| 1.01 | 11.40 | .06 | .06 | .00 | 23. | 1.01 | 23.40 | .02 | .02 | .00 | 7. |
| 1.01 | 11.45 | .06 | .06 | .00 | 23. | 1.01 | 23.45 | .02 | .02 | .00 | 7. |
| 1.01 | 11.50 | .06 | .06 | .00 | 23. | 1.01 | 23.50 | .02 | .02 | .00 | 7. |
| 1.01 | 11.55 | .06 | .06 | .00 | 23. | 1.01 | 23.55 | .02 | .02 | .00 | 7. |
| 1.01 | 12.00 | .06 | .06 | .00 | 23. | 1.02 | 0.00 | .02 | .02 | .00 | 7. |
| SUM 31.85 31.10 .75 11311. | | | | | | | | | | | |
| (809.1)(790.1) (19.1) (320.29) | | | | | | | | | | | |

| | | | | |
|------------|--------|---------|---------|--------------|
| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 53. | 125. | 39. | 39. | 1129. |
| 15. | 4. | 1. | 1. | 320. |
| CFS | 24.71 | 31.05 | 31.05 | 31.05 |
| CMS | 627.62 | 788.55 | 788.55 | 788.55 |
| INCHES | 62. | 78. | 78. | 78. |
| MM | 76. | 96. | 96. | 96. |
| AC-FT | | | | |
| THOUS CU M | | | | |

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 1

| | | | | |
|------------|--------|---------|---------|--------------|
| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 53. | 12. | 4. | 4. | 1129. |
| 2. | 0. | 0. | 0. | 32. |
| CFS | 2.47 | 3.10 | 3.10 | 3.10 |
| CMS | 62.76 | 78.86 | 78.86 | 78.86 |
| INCHES | 6. | 8. | 8. | 8. |
| MM | 8. | 10. | 10. | 10. |
| AC-FT | | | | |
| THOUS CU M | | | | |

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 2

| | | | | |
|------------|--------|---------|---------|--------------|
| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 80. | 19. | 6. | 6. | 1694. |
| 2. | 1. | 0. | 0. | 48. |
| CFS | 3.71 | 4.66 | 4.66 | 4.66 |
| CMS | 94.14 | 118.28 | 118.28 | 118.28 |
| INCHES | 9. | 12. | 12. | 12. |
| MM | 11. | 14. | 14. | 14. |
| AC-FT | | | | |
| THOUS CU M | | | | |

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 3

| | | | | | |
|------------|--------|--------|--------|--------|--------|
| CMS | 0. | 2. | 1. | 1. | 160. |
| INCHES | 12.35 | 15.52 | 15.52 | 15.52 | 15.52 |
| MM | 313.01 | 394.28 | 394.28 | 394.28 | 394.28 |
| AC-FT | 31. | 39. | 39. | 39. | 39. |
| THOUS CU M | 38. | 48. | 48. | 48. | 48. |

HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 9

| | | | | |
|------------|--------|---------|---------|--------------|
| PEAK | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
| 534. | 125. | 39. | 39. | 11294. |
| 15. | 4. | 1. | 1. | 320. |
| CMS | 24.71 | 31.05 | 31.05 | 31.05 |
| INCHES | 627.62 | 788.55 | 788.55 | 788.55 |
| MM | 62. | 78. | 78. | 78. |
| AC-FT | 76. | 96. | 96. | 96. |
| THOUS CU M | | | | |

HYDROGRAPH ROUTING

ROUTED FLOWS THROUGH RESERVOIR 10650

| | | | | | | | | |
|--------|-------|-------|-------|-------|-------|-------|--------|-------|
| ISTAQ | ICOMP | IECON | ITAPE | JPLT | JPRY | INAME | ISTAGE | IAUTO |
| 000002 | 1 | 0 | 0 | 2 | 0 | 1 | 0 | 0 |
| GLOSS | CLOSS | AVG | IRFS | ISAME | IOPT | IPMP | LSTR | |
| 0.0 | 0.000 | 0.00 | 1 | 1 | 0 | 0 | 0 | |
| NSTPS | NSTOL | LAG | AMSKK | X | TSK | STORA | ISPRAT | |
| 1 | 0 | 0 | 0.000 | 0.000 | 0.000 | -727. | -1 | |

| | | | | | | |
|-------|--------|--------|--------|--------|--------|--------|
| STAGE | 726.90 | 727.10 | 727.50 | 727.80 | 728.10 | 729.20 |
| FLOW | 0.00 | 10.00 | 50.00 | 100.00 | 250.00 | 500.00 |

| | | | | |
|---------------|------|------|------|------|
| SURFACE AREA= | 0. | 2. | 6. | 9. |
| CAPACITY= | 0. | 9. | 43. | 78. |
| ELEVATION= | 704. | 716. | 725. | 730. |

| | | | | | | | |
|-------|-------|------|------|------|------|-------|------|
| CREL | SPWID | COBW | EXPW | ELEV | COQL | CAREA | EXPL |
| 726.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |

UAM DATA

| | | | |
|-------|------|------|--------|
| TOPEL | COQD | EXPD | DAMWID |
| 727.4 | 2.9 | 1.5 | 1180. |

| | | | | | | | | | |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| CREST LENGTH | 0. | 110. | 185. | 515. | 850. | 1030. | 1125. | 1130. | 1195. |
| AT OR BELOW | | | | | | | | | |
| ELEVATION | 727.4 | 727.7 | 727.9 | 728.3 | 728.7 | 729.1 | 729.5 | 730.2 | 731.0 |

STATION 000002, PLAN 1, RTIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

STATION 000002, PLAN 1, RATIO 2 0.15PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

OVF

STATION000002

| | 0. | 10. | 20. | 30. | 40. | 50. | 60. | 70. | 80. | 0. | 0. | 0. | 0. | 0. |
|--|----|-----|-----|-----|-----|-----|-----|-----|-----|----|----|----|----|----|
| INFLOW(I), OUTFLOW(O) AND OBSERVED FLOW(=) | | | | | | | | | | | | | | |
| .05 11 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .10 21 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .15 31 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .20 41 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .25 51 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .30 61 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .35 71 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .40 81 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .45 91 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .50 101 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .55 111 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.00 121 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.05 131 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.10 141 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.15 151 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.20 161 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.25 171 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.30 181 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.35 191 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.40 201 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.45 211 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.50 221 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.55 231 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.00 241 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.05 251 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.10 261 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.15 271 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.20 281 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.25 291 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.30 301 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.35 311 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.40 321 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.45 331 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.50 341 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.55 351 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.00 361 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.05 371 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.10 381 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.15 391 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.20 401 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.25 411 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.30 421 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.35 431 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.40 441 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.45 451 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.50 461 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.55 471 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.00 481 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.05 491 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.10 501 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.15 511 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.20 521 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.25 531 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.30 541 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.35 551 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.40 561 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |

A full-page sheet of white graph paper featuring a uniform grid of small squares. The grid is composed of thin, light gray lines that intersect at regular intervals, creating a series of identical squares across the entire page. There are no margins, text, or other markings present.

PLATE D-14

PLATE D-15

STATION 000002, PLAN 1, RATIO 6 0.5 PMF

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

•0VF•

STATION000002

| | 40. | 80. | 120. | 160. | 200. | 240. | 280. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
|------|-----|-----|------|------|------|------|------|----|----|----|----|----|----|----|
| 0. | | | | | | | | | | | | | | |
| .05 | | | | | | | | | | | | | | |
| .10 | | | | | | | | | | | | | | |
| .15 | | | | | | | | | | | | | | |
| .20 | | | | | | | | | | | | | | |
| .25 | | | | | | | | | | | | | | |
| .30 | | | | | | | | | | | | | | |
| .35 | | | | | | | | | | | | | | |
| .40 | | | | | | | | | | | | | | |
| .45 | | | | | | | | | | | | | | |
| .50 | | | | | | | | | | | | | | |
| .55 | | | | | | | | | | | | | | |
| 1.00 | | | | | | | | | | | | | | |
| 1.05 | | | | | | | | | | | | | | |
| 1.10 | | | | | | | | | | | | | | |
| 1.15 | | | | | | | | | | | | | | |
| 1.20 | | | | | | | | | | | | | | |
| 1.25 | | | | | | | | | | | | | | |
| 1.30 | | | | | | | | | | | | | | |
| 1.35 | | | | | | | | | | | | | | |
| 1.40 | | | | | | | | | | | | | | |
| 1.45 | | | | | | | | | | | | | | |
| 1.50 | | | | | | | | | | | | | | |
| 1.55 | | | | | | | | | | | | | | |
| 2.00 | | | | | | | | | | | | | | |
| 2.05 | | | | | | | | | | | | | | |
| 2.10 | | | | | | | | | | | | | | |
| 2.15 | | | | | | | | | | | | | | |
| 2.20 | | | | | | | | | | | | | | |
| 2.25 | | | | | | | | | | | | | | |
| 2.30 | | | | | | | | | | | | | | |
| 2.35 | | | | | | | | | | | | | | |
| 2.40 | | | | | | | | | | | | | | |
| 2.45 | | | | | | | | | | | | | | |
| 2.50 | | | | | | | | | | | | | | |
| 2.55 | | | | | | | | | | | | | | |
| 3.00 | | | | | | | | | | | | | | |
| 3.05 | | | | | | | | | | | | | | |
| 3.10 | | | | | | | | | | | | | | |
| 3.15 | | | | | | | | | | | | | | |
| 3.20 | | | | | | | | | | | | | | |
| 3.25 | | | | | | | | | | | | | | |
| 3.30 | | | | | | | | | | | | | | |
| 3.35 | | | | | | | | | | | | | | |
| 3.40 | | | | | | | | | | | | | | |
| 3.45 | | | | | | | | | | | | | | |
| 3.50 | | | | | | | | | | | | | | |
| 3.55 | | | | | | | | | | | | | | |
| 4.00 | | | | | | | | | | | | | | |
| 4.05 | | | | | | | | | | | | | | |
| 4.10 | | | | | | | | | | | | | | |
| 4.15 | | | | | | | | | | | | | | |
| 4.20 | | | | | | | | | | | | | | |
| 4.25 | | | | | | | | | | | | | | |
| 4.30 | | | | | | | | | | | | | | |
| 4.35 | | | | | | | | | | | | | | |
| 4.40 | | | | | | | | | | | | | | |

9.45 571
 9.50 581
 9.55 591
 5.00 601
 5.05 611
 5.10 621
 5.15 631
 5.20 641
 5.25 651
 5.30 661
 5.35 671
 5.40 681
 5.45 691
 5.50 701
 5.55 711
 6.00 721
 6.05 7301
 6.10 7401
 6.15 750 1
 6.20 76.01
 6.25 77.01
 6.30 78.01
 6.35 79.01
 6.40 80.0.1
 6.45 81.0 1
 6.50 82.0 1
 6.55 83.0 1
 7.00 84.0 1
 7.05 85.0 1
 7.10 86.0 1
 7.15 87.0 1
 7.20 88.0 1
 7.25 89.0 1
 7.30 90.0.1
 7.35 91. 01
 7.40 92. 01
 7.45 93. 01
 7.50 94. 01
 7.55 95. 01
 8.00 96. 01
 8.05 97. 01
 8.10 98. 01
 8.15 99. 01
 8.20100.01
 8.25101. 01
 8.30102. 01
 8.35103. 01
 8.40104. 01
 8.45105. 01
 8.50106. 01
 8.55107. 01
 9.00108. 01
 9.05109. 01
 9.10110.01
 9.15111. 01
 9.20112. 01
 9.25113. 01
 9.30114. 01
 9.35115. 01
 9.40116. 01
 9.45117. 01
 9.50118. 1

PLATE D-21

PLATE D-22

20.15243.10
 20.20244.10
 20.25245.10
 20.30246.10
 20.35247.10
 20.40248.10
 20.45249.10
 20.50250.10
 20.55251.10
 21.00252.10
 21.05253.10
 21.10254.10
 21.15255.10
 21.20256.10
 21.25257.1
 21.30258.1
 21.35259.1
 21.40260.1
 21.45261.1
 21.50262.1
 21.55263.1
 22.00264.1
 22.05265.1
 22.10266.1
 22.15267.1
 22.20268.1
 22.25269.1
 22.30270.1
 22.35271.1
 22.40272.1
 22.45273.1
 22.50274.1
 22.55275.1
 23.00276.1
 23.05277.1
 23.10278.1
 23.15279.1
 23.20280.1
 23.25281.1
 23.30282.1
 23.35283.1
 23.40284.1
 23.45285.1
 23.50286.1
 23.55287.1
 0.00288.1

PMF

STATION 000002, PLAN 1, RATIO 9 [F] END-OF-PERIOD HYDROGRAPH ORDINATES

| OUTFLOW | | | | | | | | | |
|---------|------|------|------|------|------|------|------|------|------|
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
| 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. |
| 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. | 1. |
| 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. |
| 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. | 2. |
| 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. |
| 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. | 3. |
| 7. | 8. | 9. | 9. | 10. | 11. | 12. | 13. | 13. | 14. |
| 15. | 16. | 17. | 17. | 16. | 17. | 18. | 18. | 19. | 19. |
| 19. | 20. | 20. | 20. | 20. | 21. | 21. | 21. | 21. | 21. |
| 21. | 22. | 22. | 22. | 22. | 22. | 22. | 22. | 22. | 22. |
| 22. | 22. | 22. | 22. | 22. | 23. | 23. | 23. | 23. | 23. |
| 23. | 23. | 23. | 23. | 23. | 23. | 23. | 23. | 23. | 23. |
| 23. | 23. | 23. | 23. | 23. | 24. | 27. | 30. | 33. | 37. |
| 40. | 44. | 50. | 54. | 54. | 57. | 61. | 64. | 68. | 71. |
| 75. | 80. | 82. | 84. | 86. | 87. | 88. | 88. | 88. | 90. |
| 93. | 96. | 100. | 103. | 105. | 107. | 109. | 110. | 111. | 111. |
| 110. | 110. | 111. | 112. | 121. | 145. | 232. | 376. | 486. | 483. |
| 10. | 324. | 258. | 209. | 173. | 147. | 135. | 128. | 123. | 118. |
| 15. | 113. | 111. | 110. | 108. | 107. | 104. | 100. | 97. | 94. |
| 90. | 88. | 87. | 86. | 86. | 86. | 84. | 80. | 72. | 63. |
| 54. | 48. | 41. | 37. | 35. | 35. | 32. | 30. | 28. | 26. |
| 23. | 21. | 20. | 19. | 17. | 17. | 16. | 16. | 15. | 14. |
| 13. | 13. | 12. | 11. | 11. | 11. | 10. | 10. | 10. | 10. |
| 10. | 9. | 9. | 9. | 9. | 9. | 9. | 9. | 9. | 9. |
| 8. | 8. | 8. | 8. | 8. | 8. | 8. | 8. | 8. | 8. |
| 8. | 8. | 8. | 8. | 8. | 8. | 7. | 7. | 7. | 7. |
| 7. | 7. | 7. | 7. | 7. | 7. | 7. | 7. | 7. | 7. |
| STORAGE | | | | | | | | | |
| 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. |
| 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. |
| 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. |
| 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. | 54. |
| 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. |
| 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. |
| 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. |
| 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. |
| 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. | 55. |
| 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. |
| 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. |
| 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. |
| 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. |
| 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. |
| 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. | 57. |
| 58. | 58. | 58. | 58. | 58. | 58. | 58. | 58. | 58. | 58. |
| 59. | 59. | 59. | 59. | 59. | 59. | 59. | 59. | 59. | 59. |
| 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. |
| 60. | 60. | 60. | 60. | 60. | 61. | 61. | 62. | 63. | 63. |
| 62. | 62. | 63. | 61. | 61. | 61. | 60. | 60. | 60. | 60. |
| 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. | 60. |
| 60. | 60. | 59. | 59. | 59. | 59. | 59. | 59. | 59. | 59. |
| 58. | 58. | 58. | 58. | 58. | 57. | 57. | 57. | 57. | 57. |
| 57. | 57. | 56. | 56. | 56. | 56. | 56. | 56. | 56. | 56. |

•OVF•

STATION000002

| | 0. | 100. | 200. | 300. | 400. | 500. | 600. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
|------|-----|------|------|------|------|------|------|----|----|----|----|----|----|----|----|
| .05 | 11 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .10 | 21 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .15 | 31 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .20 | 41 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .25 | 51 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .30 | 61 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .35 | 71 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .40 | 81 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .45 | 91 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .50 | 101 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| .55 | 111 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.00 | 121 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.05 | 131 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.10 | 141 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.15 | 151 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.20 | 161 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.25 | 171 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.30 | 181 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.35 | 191 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.40 | 201 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.45 | 211 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.50 | 221 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 1.55 | 231 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.00 | 241 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.05 | 251 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.10 | 261 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.15 | 271 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.20 | 281 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.25 | 291 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.30 | 301 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.35 | 311 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.40 | 321 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.45 | 331 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.50 | 341 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 2.55 | 351 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.00 | 361 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.05 | 371 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.10 | 381 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.15 | 391 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.20 | 401 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.25 | 411 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.30 | 421 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.35 | 431 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.40 | 441 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.45 | 451 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.50 | 461 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 3.55 | 471 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.00 | 481 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.05 | 491 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.10 | 501 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.15 | 511 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.20 | 521 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.25 | 531 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.30 | 541 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.35 | 551 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |
| 4.40 | 561 | . | . | . | . | . | . | . | . | . | . | . | . | . | . |

4.45 571
4.50 591
4.55 591
5.00 601
5.05 611
5.10 621
5.15 631
5.20 641
5.25 651
5.30 661
5.35 671
5.40 681
5.45 691
5.50 701
5.55 711
6.00 721
6.05 731
6.10 7401
6.15 7501
6.20 760 1
6.25 770 1
6.30 78.01
6.35 79.01
6.40 80.01
6.45 81.01
6.50 82.01
6.55 83.01
7.00 84.01
7.05 85.01
7.10 86.01
7.15 87.01
7.20 88.01
7.25 89.01
7.30 90.01
7.35 91.01
7.40 92. 1
7.45 93. 1
7.50 94. 1
7.55 95. 1
8.00 96. 1
8.05 97. 1
8.10 98. 1
8.15 99. 1
8.20 100. 1
8.25 101. 1
8.30 102. 1
8.35 103. 1
8.40 104. 1
8.45 105. 1
8.50 106. 1
8.55 107. 1
9.00 108. 1
9.05 109. 1
9.10 110. 1
9.15 111. 1
9.20 112. 1
9.25 113. 1
9.30 114. 1
9.35 115. 1
9.40 116. 1
9.45 117. 1
9.50 118. 1

PLATE D-28

PLATE D-29

20.15243.1
20.20244.1
20.25245.1
20.30246.1
20.35247.1
20.40248.1
20.45249.1
20.50250.1
20.55251.1
21.00252.1
21.05253.1
21.10254.1
21.15255.1
21.20256.1
21.25257.1
21.30258.1
21.35259.1
21.40260.1
21.45261.1
21.50262.1
21.55263.1
22.00264.1
22.05265.1
22.10266.1
22.15267.1
22.20268.1
22.25269.1
22.30270.1
22.35271.1
22.40272.1
22.45273.1
22.50274.1
22.55275.1
23.00276.1
23.05277.1
23.10278.1
23.15279.1
23.20280.1
23.25281.1
23.30282.1
23.35283.1
23.40284.1
23.45285.1
23.50286.1
23.55287.1
0.00288.1

PLAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

| OPERATION | STATION | AREA | PLAN | RATIOS APPLIED TO FLOWS | | | | | | | | |
|---------------|---------|------|------|-------------------------|---------|---------|---------|---------|---------|---------|---------|---------|
| | | | | RATIO 1 | RATIO 2 | RATIO 3 | RATIO 4 | RATIO 5 | RATIO 6 | RATIO 7 | RATIO 8 | RATIO 9 |
| | | | | .10 | .15 | .20 | .25 | .30 | .35 | .40 | .50 | 1.00 |
| HYDROGRAPH AT | 000001 | .05 | 1 | 53. | 80. | 107. | 133. | 160. | 187. | 214. | 267. | 534. |
| | (| .12) | (| 1.51) | 2.27) | 3.02) | 3.78) | 4.53) | 5.29) | 6.05) | 7.56) | 15.12) |
| ROUTED TO | 000002 | .05 | 1 | 23. | 36. | 49. | 70. | 93. | 119. | 147. | 219. | 406. |
| | (| .12) | (| .65) | 1.02) | 1.39) | 1.97) | 2.63) | 3.37) | 4.16) | 6.21) | 13.75) |

PLAN 1

PLATE D-32

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- 8